LACUS FORUM XXXII

Networks

Dartmouth

lacus Forum 32 Referees

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LACUS FORUM XXXII

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PREFACE

The thirty-second LACUS forum was held at Dartmouth College in Hanover, New Hampshire, from August 2 to 6, 2005. The conference theme for this forum was Networks, with three sub-themes of Neurolinguistics, Computer simulation of linguistic processes, and Linguistics vis-à-vis 'Hard' Science.

The forum opened with a welcoming session by the local organizer Timothy Pulju, the provost of Dartmouth College Barry Scherr, and the chairman of the LACUS board of directors Sydney Lamb.

The inaugural lecture was given by a physicist and network theorist Reka Albert of Pennsylvania State University on 'General network theory', addressing the conference theme from a broader perspective than just linguistics. Toby Griffen of Southern Illinois University, Edwardsville, delivered the Presidential Address, 'Language and fragmentation: The case of Celtic Britain,' during the annual presidential banquet at the conclusion of the forum.

Two winners of the 2005 Presidents' Prizes were announced at the banquet, and they have the honor of having their papers included in the special category. Cristiano Broccias of the University of Auckland won the Post-Doctoral Prize for the best paper presented by a scholar who has held a doctorate or its equivalent for five years or less. His brilliant paper was on 'The English simultaneity network: The case of *as* and *while*-clauses'. John Boyle of the University of Chicago was the winner of the Pre-Doctoral Prize with his paper based on his own fieldwork, 'Switch-reference in Hidatsa: Past and present'. A pre-doctoral commendation was awarded to Christina Marshall.

The rest of the volume contains thirty-two papers, which are organized into three broad groups: Networks and neurolinguistics, Linguistics as science, and Lexicon, grammar and discourse. These papers are by presenters not only from Canada and the U.S., but also from Europe and Asia. As is the LACUS tradition, the authors range from undergraduate and graduate students to scholars who are active in teaching and those who are retired and emeritus. One thing common to them is the fact that they all love language and keep doing research on some aspect of it that is often intriguing, puzzling, and recalcitrant. The pervasive nature of language in human life and the many puzzles that are still there for us linguists to pour over and ponder on are what makes linguistics exciting and overwhelming at the same time. We trust the thirty-six papers included in this volume will give the reader some sense of joy and excitement.

There were two tutorial sessions and a workshop, and the eight presentations in these sessions were not considered for publication in this volume.

Some comments on the editorial process are in order. For nine years, the papers have been selected for publication through a referee process. The authors have several chances of revising their papers. First, when the abstracts are selected in early spring by a group of reviewers, detailed comments are often given to the authors to revise their abstracts and, sometimes, the direction of their research focus. After they present papers at the forum,

they are given about a month to revise their written version incorporating the inputs from the audience before they submit it to the editors. Then each paper is electronically sent to three reviewers whose expertise lies in the sub-field. Each reviewer rates the paper in five categories, ranging from 'Accept as is' to 'Reject', with detailed comments to improve it or why it is rejected. All these comments are conveyed to the author, who revises the paper, unless it has been rejected, following the guidelines indicated by the three reviewers. We include in the volume the list of twenty referees for the current volume and express our heartfelt appreciation for their valuable contribution.

Once the paper is accepted and revised, it is sent to the copy editor Bill Sullivan, who reads through each carefully to improve the style or sometimes suggesting more changes. Arle Lommel has done the final editing, layout, and preparation for publication as in the past several years, and Shin Ja Hwang has coordinated the peer review and paper selection. The editing process has become very thorough and arduous taking the whole year from September to July. All this, we believe, is worth it to make the reading of the LACUS volumes more enjoyable and intellectually stimulating and rewarding. We offer this volume to you with this intention and hope.

July 2006

- Shin Ja J. Hwang
William J. Sullivan
Arle R. Lommel

I

FEATURED LECTURES

INAUGURAL LECTURE

GENERAL NETWORK THEORY

Réka Albert
Pennsylvania State University

COMPLEX WEB-LIKE STRUCTURES describe a wide variety of systems of high technological and intellectual importance. For example, the cell is best described as a complex network of proteins and small molecules connected by biochemical reactions; the Internet is a complex network of routers and computers linked by various physical or wireless links; fads and ideas spread on the social network whose nodes are human beings and edges represent various social relationships; the World-Wide Web is an enormous virtual network of webpages connected by hyperlinks.

A system of elements that interact or regulate each other can be represented by a mathematical object called a graph (Bollobás 1979). Here **graph** is not used in its usual meaning of 'diagram of a functional relationship', but as 'a collection of nodes and edges', in other words, a network**.** At the simplest level, the system's elements are reduced to nodes of a graph (also called vertices) and their interactions are reduced to edges connecting pairs of nodes (see **Figure 1**, overleaf). A graph at its simplest is a connection of nodes (A, B, C…) and edges (AC, BC, CD, CJ…). The node arrangement and length of edges does not matter, only which is connected to which. Edges can be either directed, specifying a source (starting point) and a target (endpoint), or non-directed. Directed edges are suitable for representing the flow of material or of information, while non-directed edges are used to represent mutual interactions, such as collaborations. Graphs can be augmented by assigning various attributes to the nodes and edges; multi-partite graphs allow representation of different classes of node, and edges can be characterized by signs (positive for activation, negative for inhibition) as well as weights representing the confidence levels, strength or duration of the underlying processes.

1. EXAMPLES OF NETWORKS. The World-Wide Web (WWW) represents the largest network for which topological information is currently available. The nodes of the network are the documents (webpages) and the edges are the hyperlinks (URLs) that point from one document to another (see **Figure 2**, overleaf). The size of this network surpassed 1 billion nodes at the end of 1999 (Lawrence & Giles 1999).

Food webs are regularly used by ecologists to quantify the interaction between various species (Pimm 1982). In a food web the nodes are species and the edges represent predator-prey relationships between them. Social systems can be regarded as networks, where the nodes are individuals and the edges represent social interaction. The largest available **social networks** are collaboration networks of actors, where two actors are connected if they appeared in a movie together, and scientific coauthorship networks, where the nodes are the scientists and two nodes are connected if the two scientists have written an article together.

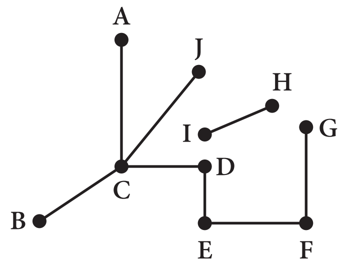


Figure 1. *Illustration of a non-directed graph.*

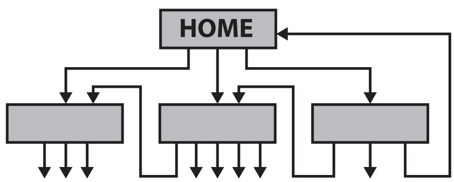


Figure 2. *Schematic of the World Wide Web.*

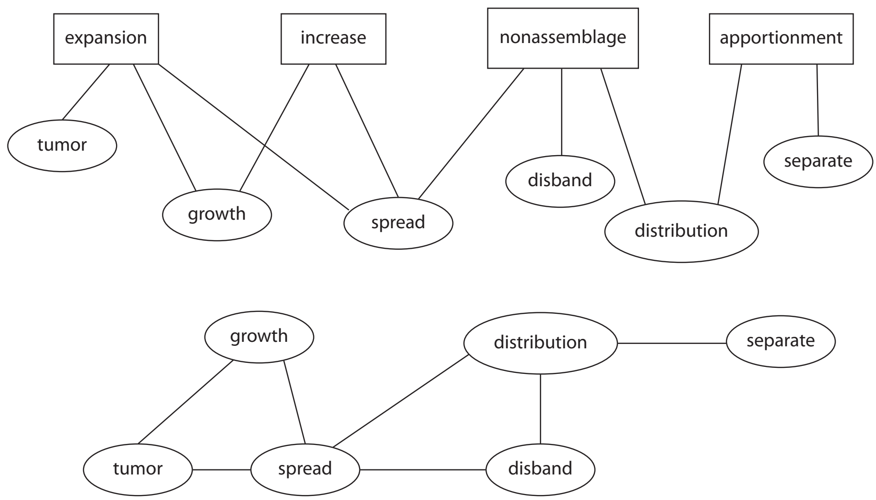


Figure 3. *Bipartite graph of a thesaurus-based semantic network (top) and its unipartite projection (bottom).*

Taxonomically organized concepts can be represented by **semantic networks** with a hierarchical tree structure (Collins & Quillian 1969). Alternative semantic networks can be constructed on thesauri such as Roget's, which includes over 29,000 words classified into 1000 semantic categories. Roget's thesaurus corresponds to a bipartite graph, illustrated in

Figure 3, in which there are two different kinds of nodes, semantic categories (squares) and words/lexemes (ovals). A connection is made between a word and a category node when the word falls into the semantic category, thus edges are allowed only between two nodes of different kinds.

To simplify the analysis of bipartite graphs, one usually constructs their unipartite projections, where only one type of node is preserved, and all nodes that shared the same neighbor in the bipartite graph are connected (see **Figure 3**). For example, collaboration networks are unipartite projections of bipartite graphs whose two types of nodes are individuals (actors, scientists) and collaborative projects (movies, articles). Steyvers and Tenenbaum (2005) constructed a projection of Roget's thesaurus in which word nodes are connected if they have at least one category in common. (Motter *et al.* 2002) arrived at a similar semantic network based on the online English Thesaurus, defining an edge between two words if either is listed as synonymous or conceptually similar to the other.

Syntactic dependency networks for several world languages have been constructed by Ferrio i Cancho, Solé & Köhler (2004). Here the nodes are words and directed edges correspond to syntactic links oriented from modifier words to head words (e.g. from the noun describing the object of an action to the verb describing the action). To obtain large-scale networks, modifier-head pairs are connected if they appear in at least one sentence in a corpus of several thousand sentences.

Relational networks (Lamb 1999) represent the connections between the strata in the brain used for a linguistic system. Each stratum provides the actualization or realization for the next higher level, and several strata are involved in the production of a sound from an initial idea (or the perception and conceptualization of a sound). Relational networks are multipartite; they contain phonemic, morphemic and lexemic nections. Moreover, the concept of a node (essentially a point, which is meaningful even if it has no edges) is substantially extended in its parallel, the nection, which includes all incoming and outgoing connections.

Free association databases, such as the University of South Florida Word Association, Rhyme and Word Fragment Norms contain pairs of cue words presented to test subjects and the first word that came to their mind when hearing the cue word. These pairs of words can be used to construct **free association networks**, where nodes are words included in the database, and an edge is drawn between a cue—response pair if more than a threshold number of participants gave the same response when given the cue word (see **Figure 4**, overleaf). A directed edge between two words is drawn if the response word (the target node) is obtained as a free association to the cue word (the source node).

Genes and gene products interact on several levels. At the genomic level, transcription factors can activate or inhibit the transcription of genes to give mRNAs. Since these transcription factors are themselves products of genes, the ultimate effect is that genes regulate each other's expression as a part of gene regulatory networks. Similarly, proteins can participate in diverse post-translational interactions that lead to modified protein functions or to formation of protein complexes that have new roles; the totality of these processes is called a protein-protein interaction network. The biochemical reactions in the cellular metabolism can likewise be integrated into a metabolic network whose fluxes are regulated by enzymes catalyzing the metabolic reactions. The nodes in such a network are genes

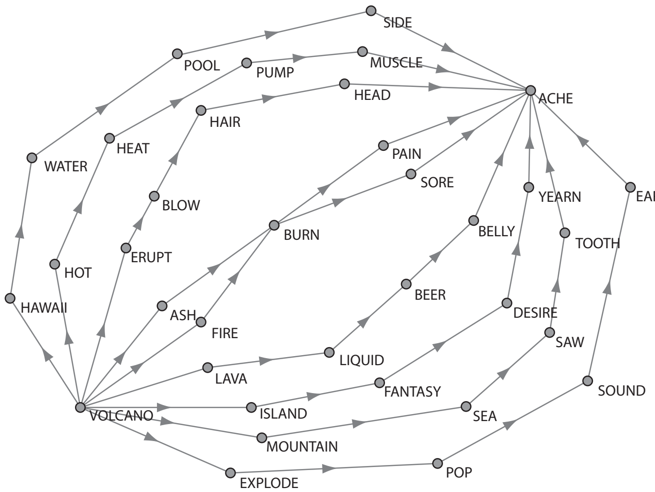


Figure 4. *Subset of a free association network from* volcano *to* ache. *(Reprinted with permission of the Cognitive Society Association. © 2005 Cognitive Society Association.)*

(DNA), mRNAs and proteins, and their edges represent mass flow or regulatory interactions. These networks are clearly multipartite, and the regulatory edges are distinguished by their activating or inhibiting nature.

In the past decade we have witnessed dramatic advances in the understanding of complex networks, prompted by several parallel developments. First, the computerization of data acquisition in all fields led to the emergence of large databases on the topology of various real networks. Second, increased computing power has allowed us to investigate networks containing millions of nodes, exploring questions that could not be addressed before. Third, the slow but noticeable breakdown of boundaries between disciplines offered researchers access to diverse databases, allowing them to uncover the generic properties of complex networks. Finally, there is a growing movement to recognize the need to move beyond reductionist approaches and to try to understand the behavior of a system as a whole. Along this route, understanding the topology of the interactions between the components, i.e. networks, is unavoidable.

Our intuition tells us that complex systems must display some organizing principles which should at some level be encoded in their topology as well. The first step is to develop tools and measures to capture in quantitative terms the underlying organization. Second, we need to go beyond the currently observable topological characteristics and explore their evolutionary roots (in the most general sense of the word). Third, we need to explore how a given network organization influences the dynamic processes taking place on the network. In the following I will review the advances towards answering each of these questions in turn.

2. NETWORK MEASURES. The nodes of a graph can be characterized by the number of edges that they have (or, the number of other nodes to which they are adjacent). This property

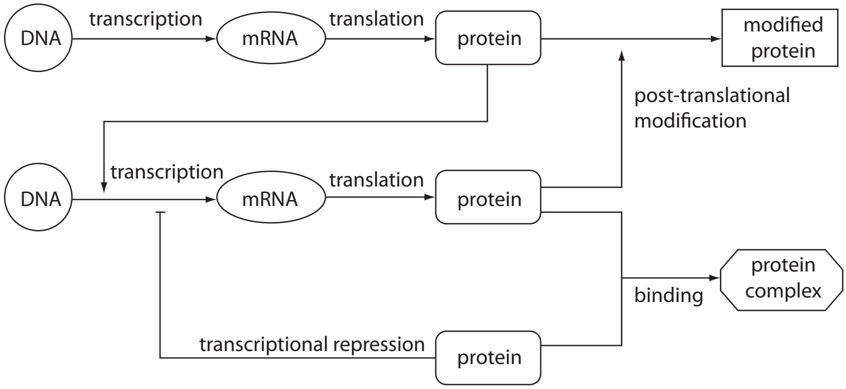
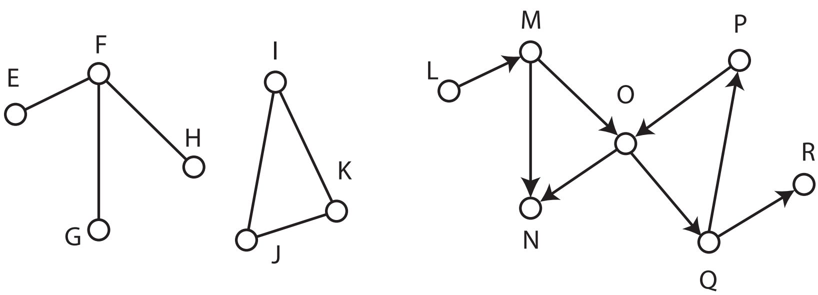


Figure 5. *A sample gene regulatory network.*



k	P(k)
1	3/7
2	3/7
3	1/7

k_{in}	$P(k_{in})$
0	1/7
1	4/7
2	2/7

k_{out}	$P(k_{out})$
0	2/7
1	2/7
2	3/7

Figure 6. *Illustration of frequently used graph measures.*

is called the **node degree**. In directed networks we distinguish the in-degree, the number of directed edges that point toward the node, and the out-degree, the number of directed edges that start at the node. For example, in **Figure 6**, node O has both in-degree and out-degree 2. Whereas node degrees characterize individual nodes, one can define a **degree distribution** to quantify the diversity of the whole network (see tables in **Figure 6**). The degree distribution $P(k)$ gives the fraction of nodes that have degree k and is obtained by counting the number of nodes $N(k)$ that have k=1, 2, 3... edges and dividing it by the total number of nodes N.

Two nodes of a graph are connected if a sequence of adjacent nodes, a path, links them (Bollobás 1979). A path in a directed network needs to follow the direction of the edges. The graph distance (also called path length) between two nodes is defined as the number of edges along the shortest path connecting them; if the two nodes are disconnected, the

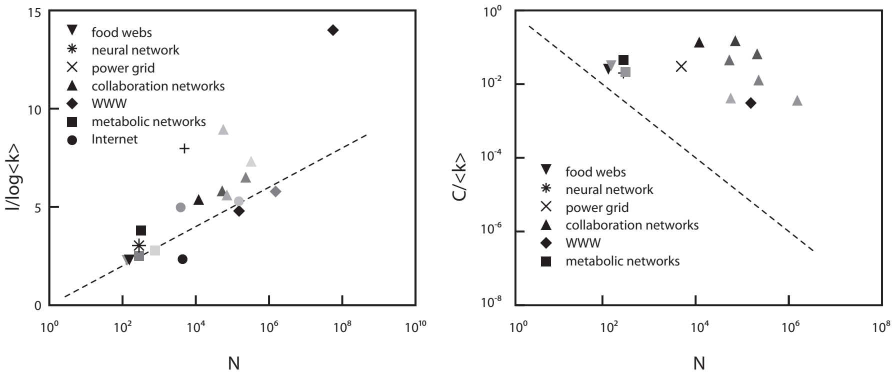


Figure 7. *Comparison between the average path length (left) and average clustering coefficient (right) of real networks. The dashed lines represent the predictions of random graph theory.*

distance is infinity. If a path connects each pair of nodes, the graph is said to be connected; if this is not the case one can find connected components, graph regions (subgraphs) that are connected. The connectivity structure of directed graphs presents special features, because the path between two nodes *i* and *j* can be different when going from *i* to *j* or vice versa. For example, in **Figure 6**, the distance between nodes *P* and *O* is 1, and the distance between nodes *O* and *P* is 2 (along the OQP path).

Various networks, especially social networks, are abundant in cliques, subgraphs where every node is connected to every other node. We quantify how close the local neighborhood of a node is to being part of a **clique** by the **clustering coefficient** C_i, defined as the ratio between the number of edges linking nodes adjacent to *i* and the total possible number of edges among them (Watts & Strogatz 1998). For example, the clustering coefficient of node I in **Figure 6** is 1, indicating that it is part of a three-node clique. The general cohesiveness of the network is quantified by the average clustering coefficient of all nodes.

Despite their often large size, in most networks there is a relatively short path between any two nodes. The most popular manifestation of 'small worlds' is the **six degrees of separation** concept, uncovered by the social psychologist Stanley Milgram (1967), who concluded that there was a path of acquaintances with typical length of about six between most pairs of people in the United States. Various networks, including collaboration networks and the power grid, also display a high average clustering coefficient, which indicates a high level of redundancy and cohesiveness. Plotting the average path length and average clustering coefficient of diverse networks as a function of their size reveals a remarkably consistent trend: it is as though these different networks were members of the same family (see **Figure 7**).

Further universality is observed if we measure diverse networks' degree distribution. The degree distribution of numerous networks, such as the World-wide web, Internet, human collaboration networks and metabolic networks, follows a well-defined functional form called a power law (Barabási & Albert 1999; Jeong *et al.* 2000; Wagner & Fell 2001).

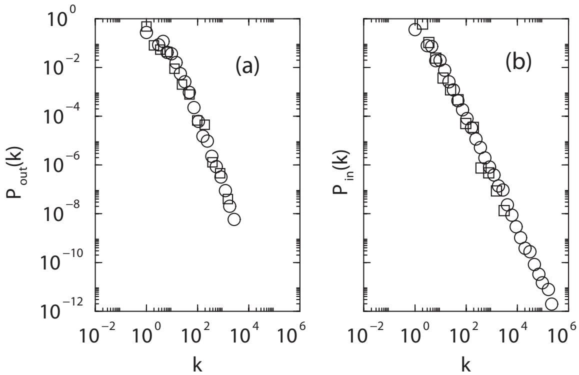


Figure 8. *The distribution of out-degrees (left) and in-degrees (right) in two World-Wide Web networks: (Albert et al. 1999), squares and (Broder et al. 2000), circles.*

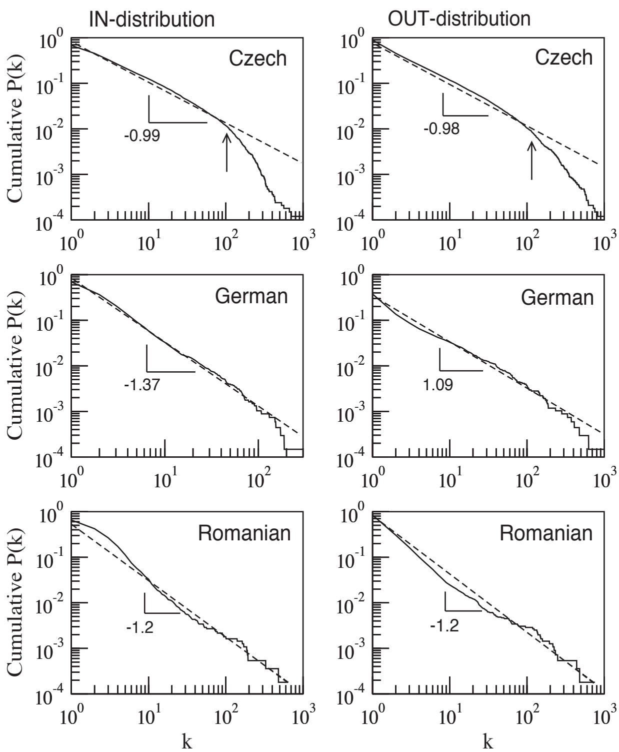


Figure 9. *Cumulative in- and out-degree distribution of Czech, German and Romanian syntactic dependency networks. (Reprinted with permission from R. Ferro i Cancho, R. V. Solé & R. Kohler,* Physical Review E *69(5):4, 051915 (2004). Copyright 2004 by the American Physical Society.)*

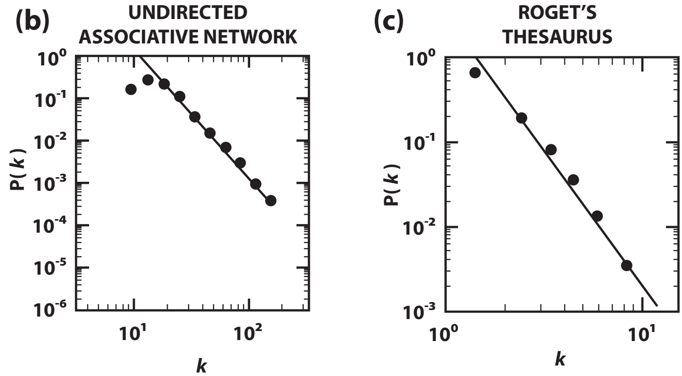


Figure 10. The degree distribution of two different semantic networks, both constructed by Steyvers and Tenenbaum (2005). (Reprinted with permission of the Cognitive Society Association. © 2005 Cognitive Society Association.)

Here A is a normalization constant that ensures that the $P(k)$ values add up to one, and the **degree exponent** γ is usually in the range $2<\gamma<3$ (Albert & Barabási 2002). This function indicates a high diversity of node degrees: nodes with small degrees are most frequent; however, very highly connected nodes (hubs) are also present. Because there is no typical node in the network that could be used to characterize the rest of the nodes, these networks are described as **scale-free**. **Figures 8–10** illustrate the degree distributions of four different networks, the World-Wide Web, two types of semantic networks and syntactic dependency networks. All distributions are plotted in a double logarithmic scale in which a power law corresponds to a straight line.

Note that not all networks are scale-free. For example, the power grid's degree distribution is an exponential function that decays much faster than a power law. This indicates that there are no or only minor hubs in these networks.

3. NETWORK MODELS. The simplest approach to complex networks with a seemingly random topology is to determine their expected properties on the basis of the number of nodes and edges alone. For answers we need to turn to random graph theory, a well-developed branch of discrete mathematics founded on the pioneering work of Pál Erdős and Alfréd Rényi.

To construct a **random graph**, we start with N nodes, and then every pair of nodes is connected with probability p. At $p=0$ the graph consists of N isolated nodes, and at $p=1$ the graph is fully connected. The greatest discovery of Erdős and Rényi was that many important properties of random graphs depend sensitively on p; that is, at a given connection probability either almost every graph contains fully connected subgraphs (or is connected), or on the contrary, almost no graph has them (or is disconnected).

Since in a random graph the edges are placed randomly, the majority of nodes have approximately the same degree, close to the average degree $<k>$ of the network. The degree distribution of a random graph is a binomial distribution with a peak at $P(<k>)$ (see

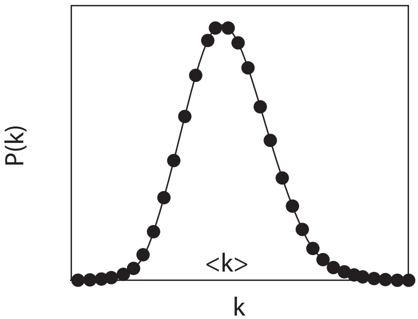


Figure 11. *The bell-shaped degree distribution of a random graph.*

Figure 11). Random graphs have small diameters, provided p is not too small. The reason for this is that a random graph is likely to be spreading: a given node has about $<k>$ first neighbors, $<k>^2$ second neighbors and so on. As a consequence the average path-length of a random graph is

$$l_{rand} = \frac{logN}{log < k >}$$

thus it depends logarithmically on the number of nodes alone. If we consider a node and its first neighbors, the probability that two of these neighbors are connected is equal with the probability that two randomly selected nodes are connected (that is, the connection probability p). Consequently the clustering coefficient of a random graph is

$$C_{rand} \cong p = \frac{< k >}{N}$$

a value that consistently decreases as the size of the graph increases.

How successful are random graphs as models of real networks? As we can see from **Figure 7**, the path-length of real networks is consistent with the path-length of comparable random graphs. However, the clustering coefficient of real networks does not follow the decreasing trend of random graphs, but rather is independent of network size. The strongest discrepancy is in the degree distribution. The bell-shaped degree distribution of random graphs peaks at the average degree and decreases fast for both smaller and larger degrees, indicating that these graphs are statistically homogeneous. In contrast, the power-law degree distribution indicates a heterogeneous structure with a broad degree range, from very low to very high degrees

In **Figure 7** we see that real-world networks have a small-world character like random graphs, but they have unusually large and system size-independent clustering coefficients. This latter property is characteristic of ordered lattices, whose clustering coefficient is size independent and depends only on the coordination number. For example, a one-dimensional lattice with periodic boundary conditions (i.e. a ring of nodes), in which

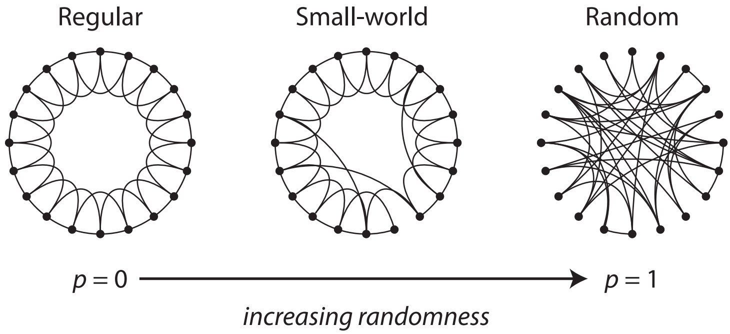


Figure 12. *A combination of small distances with large clustering coefficient is attainable in the Watts-Strogatz model by varying the rewiring probability p. (Adapted by permission from Macmillan Publishers Ltd:* Nature *393 (6684): 440–42, copyright 1998.)*

each node is connected to the K nodes closest to it, see **Figure 12**), most of the immediate neighbors of any site are also neighbors of one another, i.e. the lattice is clustered. Such regular lattices, however, do not have short path lengths: for a one-dimensional chain the average node-node distance increases proportionally with N, which is much faster than that observed for random and real graphs. Watts and Strogatz (1998) propose a one-parameter model that interpolates between an ordered lattice and a random graph. Starting with a ring lattice in which every node is connected to its first K neighbors, each edge is rewired with probability p such that self-connections and duplicate edges are excluded (see **Figure 12**). By varying p, the transition between order ($p=0$) and randomness ($p=1$) can be closely monitored. They observed that even a relatively low number of rewired edges is sufficient to decrease the average path length drastically, yet locally the network remains highly ordered.

Each node of the starting lattice has degree K. Rewiring does not change the average degree, nor the qualitative features of the degree distribution. Similarly to random graphs, the degree distribution has a peak at $P(<k>)$ and very high degrees have exponentially small probabilities.

Neither random graph theory nor the Watts-Strogatz model can reproduce the scale-free degree distribution of most real networks. Accounting for this feature necessitates a shift from modeling network topology to modeling network assembly. Barabási and Albert (1999) argue that the scale-free nature of real networks is rooted in two generic mechanisms shared by many real networks. First, most real world networks describe open systems which grow by the continuous addition of new nodes. Second, real networks exhibit preferential attachment, such that the likelihood of connecting to a node depends on the node's degree. For example, a webpage will more likely include hyperlinks to popular documents with already high degree, because such highly connected documents are easy to find and thus well known, or a new manuscript is more likely to cite a well known and thus much cited publications than less cited and consequently less known papers.

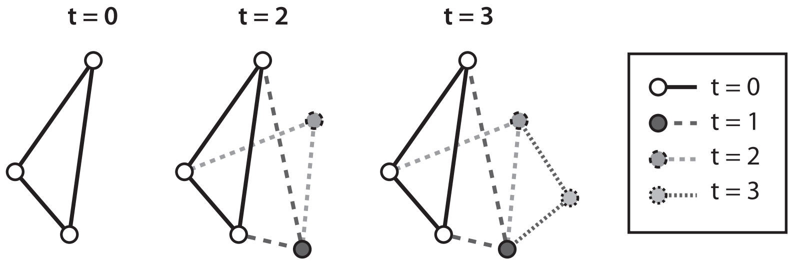


Figure 13. *Illustration of the growth algorithm of the Barabási-Albert model.*

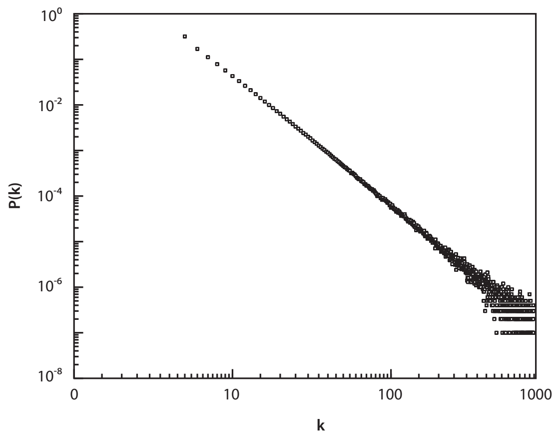


Figure 14. *The degree distribution of networks grown by the Barabási-Albert model is a power-law with exponent γ=3.*

The Barabási-Albert model makes the simplest assumptions about the rates of growth and preferential attachment. Starting with a small seed network (usually a triangle of three nodes and three edges, as in **Figure 13**), at every timestep we add a new node with m edges that link the new node to m different nodes already present in the system. **Figure 13** illustrates the case when $m=2$; at each timepoint one new node and two new edges are added, which are distinguished from the existing nodes and edges by using a different shade and type of dashed line, as shown in the legend. The darkest gray node and edges were added at $t=1$ (not shown for simplicity). When choosing the nodes to which the new node connects, we assume that the probability $\Pi(k_i)$ that a new node will be connected to node i is proportional with the degree k_i of node i:

$$\Pi(k_i) = \frac{k_i}{\Sigma_j k_j}$$

Networks generated in this way have a power-law degree distribution $P(k) \sim k^{-3}$ (see **Figure 14**), thus they can describe the higher end of the observed degree exponent range.

Similarly to random graphs, the average clustering coefficient in this model decreases with increasing network size (Ravasz *et al.* 2002). The average path length is slightly smaller than that in comparable random graphs (Bollobás 2003).

The Barabási-Albert model is a minimal model with several limitations: it predicts a power-law degree distribution with a fixed exponent, while the exponents measured for real networks vary between 1 and 3; moreover it does not capture the high clustering coefficient of real networks. There is now a vast literature of evolving network models that offer improvements to this generic model; these include the incorporation of network evolution constraints and the identification of system-specific mechanisms responsible for preferential attachment (Albert & Barabási 2002). Several evolving network models also correctly reflect the local order of real networks.

Among the many evolving network models, I would like to present in particular the Steyvers-Tenenbaum (2005) model that describes the lexical development of an individual as a process of semantic network assembly and evolution. Here the nodes of the semantic network are words, and the connections between nodes represent semantic associations or relations. The Steyvers-Tenenbaum model assumes that semantic structures grow primarily through differentiation: the meaning of a new word is a variation on the meaning of an existing word. Specifically, when a new node is added to the network, it acquires a pattern of connections that corresponds to a subset of an existing node's connections.

The algorithm of the Steyvers-Tenenbaum model has three ingredients. First is growth, or the addition of a node and m edges at each timestep. Second is preferential selection: the probability of the new node differentiating a particular node i is assumed to be proportional to node i's current complexity, reflected in its degree, thus:

$$\Pi(k_i) = \frac{k_i}{\Sigma_j k_j}$$

Third, attachment to m neighbors of node i: the probability of connecting to a node j in the neighborhood of node i is proportional to the usage frequency of the corresponding concept:

$$\Pi(u_i) = \frac{u_j}{\Sigma_{I \in H} u_I}$$

Figure 15 illustrates the growth algorithm of the Steyvers-Tenenbaum model for $m=2$. At each timestep a new node and two new edges are added, colored gray at $t=1$ and depicted with dashed lines at $t=2$. The new node will connect to two neighbors of a preferentially selected target node, distinguished by having a border pattern or color identical to that of the new node and edges.

Steyvers and Tenenbaum select the value of the parameter m and the number of timesteps such that the size and the average degree of their model network equals those of the free word association network (see **Figures 4** and **10**), then compare the two networks. They find remarkable agreement between the model and real degree distribution,

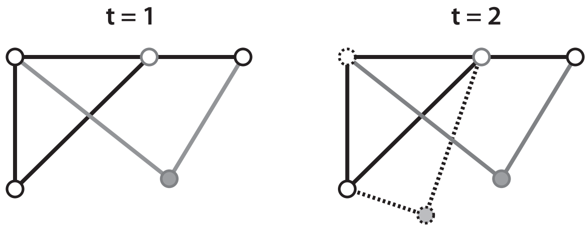


Figure 15. *Illustration of the algorithm of the Steyvers-Tenenbaum model. Gray lines indicate t = 1 and dashed lines t = 2.*

average distance and clustering coefficient. The trend followed by the clustering coefficient for increasing network sizes is not reported, however it seems that this model accomplished the feat of being both scale-free and small-world (locally ordered). What is the intuitive explanation for this? On the first count, the copying mechanism invoked (connecting to the neighbors of a selected node) is known to lead to an effective preferential attachment. On the second, the growth algorithm leads to the proliferation of triangles: if the selected two neighbors are connected (as in the right panel of **Figure 15**), the new node's connecting to them will create a new triangle.

4. INTERPLAY BETWEEN TOPOLOGY AND DYNAMICS. Many complex systems display a surprising degree of tolerance against errors. For example, relatively simple organisms grow, persist and reproduce despite drastic pharmaceutical or environmental interventions, an error tolerance attributed to the redundancy of the underlying metabolic and genetic network. But could the network topology, beyond redundancy, play a role in the error tolerance of such complex systems? Let us first focus on the topological aspects, specifically the effects of node removal. The disappearance of a node implies the removal of all edges that connect it to it, disrupting some of the paths between the remaining nodes. This can cause an increase in the node distances (as the previously used shortest path has disappeared), or in more severe cases a separation into isolated clusters (if all paths between a subset of nodes disappeared).

It is now shown both numerically and analytically that scale-free networks exhibit a remarkable resilience to random errors. Even after a significant fraction of nodes is lost, the majority of the remaining nodes are connected and their distances increase only slightly. On the negative side, scale-free networks are vulnerable to the loss of the highest degree nodes. **Figure 16** presents the relative size of the largest cluster that remains connected (open symbols) and the average path length of this cluster (filled symbols), when a fraction *f* of the nodes are removed from the network describing the Internet (left) and World-Wide Web (right). Two removal scenarios are shown: random errors (gray) and targeted attack of high-degree nodes (black). As documented by the figure, the Internet and World Wide Web are resilient to the random failure of ~50% of the nodes, but break down when 5% of the nodes are eliminated selectively. Gene mutation (knockout) experiments indicate that as much as 73% of the S. cerevisiae genes are non-essential, confirming the robustness of cellular networks in the face of random disruptions. The likelihood that a gene is essential

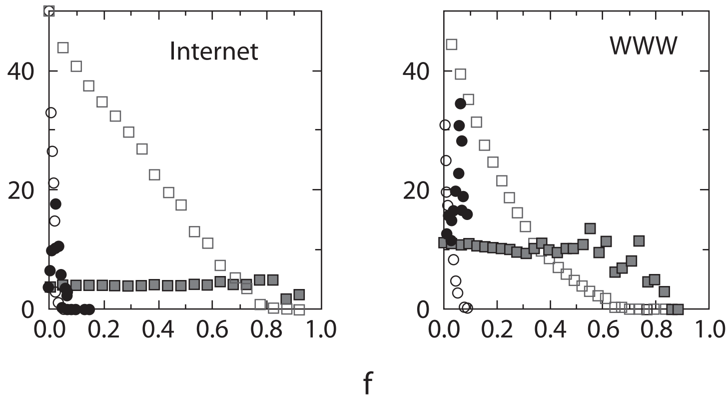


Figure 16. *Simulated response of the Internet and World-Wide Web to the loss of a fraction f of nodes.*

(lethal) correlates with the number of interactions its protein product has, indicating the cell's vulnerability to the loss of highly interactive hubs (Jeong *et al.* 2001).

There is increasing evidence that the dynamic behavior of complex systems is profoundly influenced by their topological organization. For example, the topology of human contact networks, the substrate of disease spreading, determines the emergence of epidemics, diseases that encompass a large fraction of the population. Pastor-Satorras and Vespignani (2001) showed that while for random networks a local infection spreads to the whole network only if the spreading rate is larger than a critical value, for scale-free networks any spreading rate leads to the infection of the whole network. That is, for scale-free networks the critical spreading rate reduces to zero, a highly unexpected result that goes against volumes of results written on this topic.

Not all possible molecular interactions are present and active at the same time or in a given cellular location *in vivo*. Cellular network topology needs to be complemented by a description of network dynamics—the states of the nodes and changes in those states. In principle the dynamics and function of cellular networks could depend crucially on fine-tuned values of kinetic parameters; however, several models and experiments suggest that regulatory networks maintain their function even when faced with fluctuations in components and reaction rates (Alon *et al.* 1999). These observations lend support to the conclusion that correct dynamics and function is chiefly based on the topology of the regulatory networks. Indeed, we (Albert & Othmer 2003) have recently shown that a detailed reconstruction of the regulatory interactions among members of a group of genes, paired with a coarse-grained description of these gene's functional states, led to a remarkably successful description of both normal (wild type) and mutant biological behavior. It remains to be seen which network measures will prove most informative and predictive, but path redundancy and feedback loops are strong candidates.

In conclusion, there is now a significant body of work going back to the 1950's indicating that graph theory and network modeling allow important insights into the organization

of complex systems. Network synthesis, visualization, analysis and modeling are pursued across disciplines, especially recently. The shift that we experienced in the past six years in our understanding of networks has been rather swift and unexpected. We have learned through empirical studies, models, and analytic approaches that real networks display generic organizational principles shared by rather different systems. Yet, these results are only the tip of the iceberg. It is still an open question whether there are general descriptors and principles of network dynamics or each type of system has a specific dynamic behavior. For example, the relatively uncharted territory of semantic network dynamics may hide strong connections to cognition, memory and learning. The emerging concepts and ideas related to network dynamics and function might turn out to be just as exciting as those encountered so far.

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PRESIDENTIAL ADDRESS

LANGUAGE AND FRAGMENTATION: THE CASE OF CELTIC BRITAIN

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AS LINGUISTS, we tend to have a rather high regard for language, the object of our study. As we read in introductory linguistics texts, language is used to bind people together into a common community through communication. This interpretation of language is all very well and good. However, there is another, darker side of the phenomenon—one that serves not to bind a culture together, but rather to fragment humanity into separate, opposed communities.

1. LANGUAGE IN BRITAIN. One of the most fascinating cases of the interaction of language and culture can be found in Britain. Traditionally, the island has been associated with the Celts; but as we shall see, the situation is considerably more complicated.

1.1. FROM CELTIC TO ENGLISH. Let us begin with the Anglicization of the region of northern Britain generally known as Scotland, though more neutrally termed Alba. In the early Middle Ages, the Picts were merging their culture with that of the Scots, culminating in the mid ninth century in the reign of the first pan-Alban king Kenneth MacAlpin, with his Scots Gaelic name and his Pictish patronymic. There was also a third Celtic cultural influence in the region—the Northern Britons, who were closely related to the Welsh. Into this mix came the English from Northumbria.

As observed by Munro Chadwick:

> [T]here can be no doubt that large parts of Britain, and especially of Scotland, have changed their language more than once, without any considerable displacement of population. Since *c.* 1100 Gaelic has gradually been displaced by English throughout the greater part of Scotland. Before that there must have been a very long period of fluctuation between Gaelic and Welsh, towards the end of which—especially after the union of the Picts and Scots in the ninth century—Gaelic quickly gained the upper hand. There is some reason for suspecting, e.g., that Glasgow became Gaelic before it became English, i.e. that it changed its language twice in less than two centuries. (1949:77)

Of course, the fact that the language changed while the population remained the same has profound implications for the culture. Certainly in long-lived families, one generation may well have learned important cultural characteristics – from farming techniques to matters of religion—from elders who spoke a different language; and that later generation could then have transmitted this knowledge to their descendants who spoke yet another language.

In this sequential exchange, the first two languages involved would have been Celtic. The third, however, would have been Germanic. In the history of Britain—and particularly in the emotional history—this final stage is extremely problematic, for the first two generations would have been considered Celts and the third would have been considered the distinctly foreign English.

Archaeological and even biological evidence, however, indicates that the English are anything but foreign to the Celtic inhabitants of Britain. A simple examination of the population density of Britain through the period in question and up into the present indicates that the Germanic invaders of the early Middle Ages did not depopulate England of Celtic inhabitants and then repopulate it with English. Such a scenario would have been out of the question, '[g]iven that the number of Anglo-Saxon migrants to Britain was probably of the order of tens of thousands, as against an indigenous population probably numbering in the millions...' (Cleary 1989:204). Nora Chadwick (1963) goes into impressive detail on the size and abilities of the period ships to question how such a migration could have consisted of 'enough people to displace or even supersede in numbers a population of 1,500 years' standing' (1963:112, though we should note that these years count only the Celtic culture—see below), especially since in the contemporary account, 'women were never said to accompany them' (1963:113).

Nor does the archaeological evidence support the traditional depopulation-repopulation scenario. For example, Pam Crabtree points out 'long-term continuities in animal husbandry practices and hunting patterns between Early Anglo-Saxon and Iron Age and Roman sites in southeastern Britain' (1991:33). As Esmonde Cleary observes:

> Cemeteries, settlements, landholdings: for all of these a case can be made that there was British influence on what have traditionally been thought of as Anglo-Saxon institutions. Indeed, they are easier to explain if one envisages such influence than if one tries simply to explain them in terms of Anglo-Saxon practices. If we accept this, then it is clear that there was... continuity at the level of the basic subsistence economy and social unit... (1989:204–5—compare also Alcock 1971.)

Even such culturally specific aspects as religious attitudes show a seamless continuation from Celtic to English. For example, the famous Pelagian heresy was perhaps the most definitive and widespread mark of the Celtic Church. It is still very prevalent in Britain today, where it is identified in theological circles as 'the English disease' (Rees 1988:ix).

What happened in England was not some kind of full-scale invasion and genocide. Rather, it was simply a change in the 'élite dominant' class—the rulers and manorial lords (compare the approach of Renfrew 1987). The reason why English became so widespread so quickly was that the Britons already had a foreign prestige language in Latin. While the rural populations spoke some form of Brythonic akin to Welsh, those in the market centers spoke Latin. When the English took over the markets, the old foreign prestige language was simply replaced by a new one; and when they took over the manors, English spread to the rural populations as well. (Compare Davis 1982:121–24.)

Thus, there was no significant change in the general population between Celtic and English rule. Indeed English customs show far more affinities with the Celtic than they do with the Germanic (see for example, MacNeill 1962); and even in the popular media, it has seriously been suggested that with regard to culture, Anglo-Saxon may well be less precise a term than Anglo-Celtic, as we see, for example, in the BBC television series *The Celts* (1986—compare also the quote above from Cleary 1989).

1.2. FROM PRE-CELTIC TO CELTIC. The general situation of stability, however, does not begin with the transition from Celtic to English. Let us therefore go back in time and examine the Celticization of Britain.

In the previous LACUS Forum (Griffen 2005), we saw some evidence of cultural continuity from the pre-Celtic population to the Celtic population of Britain with regard to the ogam script. It was demonstrated that ogam had to have developed into the familiar signary well before the seventh century BCE to account for the signary's arrangement, comparative evidence, and the dating of certain sound changes. Moreover, the artistic motifs that could have supported the form of the script arose during the megalithic period in Britain and Ireland, well before the culture we generally recognize as Celtic. In the interim, the artistic motifs led to a tally system that was adapted to a writing system that was only at that point adopted by the Indo-European Celts. Thus, the quintessential Celtic writing system was actually inherited from the pre-Celtic population.

The archaeological evidence of cultural continuity simply abounds. In summarizing the findings of continuity in the physical evidence for the transition between the Bronze Age and the 'Celtic' Iron Age, F.R. Hodson observes:

> It is difficult to reconcile this abundant evidence for direct continuity between Bronze and Iron Age settlement traditions with the usual interpretation that sites like All Cannings Cross, Park Brow or Bodrifty represent essentially the settlement of continental Iron Age elements or, more specifically 'Hallstatt' elements in Britain. If all the other evidence really pointed to Hallstatt invaders it would have to be weighed against the evidence for continuity just mentioned, but when examined in detail at a key site like Eastbourne, 'Hallstatt' evidence proves most ambiguous... In fact, the pottery from these sites seems to provide a good example of the phenomenon of *cultural archaism*—a constant feature of some areas in Europe that are peripheral to, but still just in touch with the main centres of development. (1964:104–5)

Perhaps the most interesting insights to be gained from all of this archaeological continuity and its underlying regional diversity have been summarized by Simon James in his book *The Atlantic Celts: Ancient People or Modern Invention?* He notes:

> Under such circumstances, 'Celtic', or indeed even 'British' or 'Irish' are not especially useful even as loose cultural terms, because these abstractions mask the apparent real situation of many autonomous local or regional communities, or in some

areas and periods even a continuum of farming families with little overall group structure beyond short-range kinship links, and few signs of any sense of particular unitary identity. (1999:79)

1.3. THE DNA EVIDENCE. Backing up this historical and archaeological evidence is some recent DNA evidence. As recounted by Barham *et al.* (1999), DNA was extracted from a Palaeolithic skeleton in Gough's Cave in the vicinity of Cheddar, England. An exact genetic match of mitochondrial DNA (indicating common matrilineal descent) was identified in a man living within a mile of the site; and indeed, more matches have since been found. What 'Cheddar Man' demonstrates is that the population has remained remarkably stable for nine millennia in an area that has experienced numerous changes in culture, from the various 'lithics' to the Bronze Age peoples, the Iron Age Celts, the Romans, the Anglo-Saxons, and the Normans. Clearly, this DNA evidence—bolstered by more extensive DNA studies of the entire British population (Barham *et al.* 1999, Cavalli-Sforza 2000)—shows that these were not mass invasions involving depopulation and repopulation in the tradition of Gordon Childe (1940).

1.4. THE 'SEMANTIC ACCENT'. Indeed, it can even be argued from a linguistic point of view that on a 'deeper', semantic level, not even the languages in the area in question have 'significantly' changed. As John Lucy demonstrated in his lecture on 'The Impact of Language Diversity on Thought' (2004) in last year's Forum, when speakers of one language are required to change to another language in their cultural interaction, they acquire the second language with a 'semantic accent'. Just as the acquisition of the phonology entails the substitution of familiar native sounds for the new foreign sounds (and in this regard, compare the experimental evidence of Scholes 1968), the acquisition of the semantic structure experiences the same type of substitution.

Thus, while the apparent meanings and structures seem to follow those of the new language, they are in actuality a continuation of those of the old language. It is therefore of no surprise whatsoever that important cultural concepts could have been passed on from Northern British to Scots Gaelic to Anglo-Saxon within two centuries in Glasgow—and this without any breakdown in the fabric of society.

What we find here is no wholesale change in language, but rather a change in speech. To paraphrase Roger Bacon, at least in the context of such an historical situation, the languages 'vary accidentally' (Lyons 1968:15-16).

2. THE WELSH FACTOR. Now that the historical, archaeological, biological, and linguistic evidences have all rather firmly established the fact that Britain has remained remarkably stable both in population and in cultural continuity for millennia, we need to ask just what *has* changed. As we have observed in the transitions in Glasgow, the major changes in Britain have primarily been linguistic, if only in the 'surface' realization of the spoken and written language (that is to say, on the morphosyntactic rather than the semantic level).

In the overall scheme of things, especially given the example of early medieval Glasgow, these linguistic changes should not have been so terribly important. As we see in the cases

of those speaking the surviving Celtic languages, however, these language changes have been all-important. Let us examine, in particular, language attitudes in Wales.

While Scots Gaelic appears to have declined largely through economic and social evolution, Welsh speakers have been subjected to ridicule, intimidation, and even physical abuse for the sake of English-language conformity. Consequently, the nationalistic answer to this situation involves a great deal of emphasis upon the Welsh language.

As we have seen above, the 'semantic accent' of English is far more closely related with Welsh than it is with German. Nonetheless, the English rarely use the neutral term *Cambrians* to identify the Welsh, but prefer the Anglo-Saxon term for 'foreigners'. On their part, the Welsh still to this day identify the English as *Saeson* 'Saxons', although their name for the region of England is the more neutral *Lloegr*. It is thus in the terminology of their respective languages that both sides have drawn the lines of fragmentation.

Perhaps no other institution more graphically illustrates the forced 'Saxonization' of the Welsh more than the infamous 'Welsh Not'. School children who were caught speaking Welsh were beaten by their teachers and forced to wear a block of wood from a cord around their necks. This was the signal for others to ridicule, ostracize, and strike the offending children. Children were even encouraged to betray their own classmates by passing the Welsh Not on to anyone they heard speaking Welsh, with the understanding that the last child to be wearing the Welsh Not would be severely beaten at the end of the day—a practice that could indeed have devastating social ramifications. That this abuse continued into the twentieth century is particularly galling to the Welsh (compare Khleif 1980:114 among many).

Such discrimination, especially by the government, can be found in many sources, perhaps most famous among them being Peter Berresford Ellis' *Wales—A Nation Again* (1968). Most of the incidents involve, in one way or another, the Welsh language, including various attempts to allow testimony in Welsh in courts within Wales, which was not officially even considered until the Welsh Language Bill of 1967 (Ellis 1968:148).

Then there is the well-known incident in which a Welsh Member of Parliament rose and spoke in Welsh. After the English Members filled the chamber with derisive laughter, they learned they had been maneuvered into ridiculing the Lord's Prayer (see, for example, Ellis 1968:163). Such taunts and acts of civil disobedience are mirrored in the bothersome habit observed by this researcher of Welsh speakers painting over the English portions of road signs and of English speakers painting over the Welsh portions.

By this point it should be rather clear that the main battleground between the Welsh and the English lies over the language of use in Wales. Indeed, the chorus of the national anthem of Wales ends with *O bydded i'r hen iaith barhau* 'Oh, may the old language endure'. Welsh newspapers and books constantly refer to statistics to determine how many speakers of Welsh there are, and this is taken as an indication of how viable the Welsh culture is (compare, for example, Morgan 1966, Aitchison & Carter 2000).

In this researcher's travels in Wales, however, it has been very clear that the Anglophone Welsh—far from being an oxymoron—are in fact to be found in abundance, especially when confronted by an American who attempts to speak with them in Welsh. They consistently identify themselves as Welsh, although they apologize profusely for not speaking 'their own' language.

Now, if Welshness in general is to be defined through language, how can non-Welsh speakers consider themselves Welsh? The justification is quite clearly that these are people who live in the area and whose families spoke Welsh until the recent past. This identifies them as quite distinct from their relatives in England, whose families spoke a similar language in the distant past. They thus perpetuate the perception that they are the native Celts of the island and the English are German invaders—as they have indeed been judging the situation since the early Middle Ages (compare Griffen 2001).

3. THE FRAGMENTATION OF SOCIETY BY LANGUAGE. It is in such fine distinctions based upon language as spoken that such drastic fragmentation of society is grounded. Both sides are descended from the earliest Britons, and there is no reason why the Welsh should consider the English German invaders and the English consider the Welsh foreigners except for the languages they speak—languages that to some degree still share a semantic component through the historical 'semantic accent', reinforced through time by a great deal of English influence on Welsh as well (compare Parry-Williams 1923).

In fact, there is no reason why both should not see themselves as common descendants of the pre-Celtic peoples who lived in Gough's Cave and who later built Stonehenge. To be sure, there is no reason why each should not respect the other's language and appreciate the diversity and the insights into their common British heritage to which these languages so eloquently attest (compare Williams 1979:32–33).

This fragmentation of British society is repeated often enough throughout the world, particularly in such areas of colonization as Latin America, where Spanish-speaking descendants of the aboriginal peoples consider themselves to be as thoroughly Spanish as the English consider themselves to be purely Anglo-Saxon; and, to be sure, both are often just as condescending to their relatives who speak the indigenous languages. Although the experience of Glasgow should be a strong enough indication by itself that the precise language used is not all that important, the fragmentation along language lines is a rather stark lesson that language, even while not all that important, can be downright dangerous.

The danger has, of course, nothing to do with the languages *per se*. Rather, it has to do with the perceptions—or more precisely the misperceptions—of speakers with regard to the role of language. Clearly the Welsh speakers and the English speakers use the language difference as a means of division because they perceive that this division is 'real'.

In his *Wholeness and the Implicate Order*, the great twentieth-century physicist and philosopher David Bohm makes the following observation:

> [T]he process of division is a way of *thinking about things* that is convenient and useful mainly in the domain of practical, technical and functional activities (e.g. to divide up an area of land into different fields where various crops are to be grown). However, when this mode of thought is applied more broadly to man's notion of himself and the whole world in which he lives (i.e. to his self-world view), then man ceases to regard the resulting divisions as merely useful or convenient and begins to see and experience himself and his world as actually constituted of separately existent fragments. Being guided by a fragmentary self-world view, man then

> acts in such a way as to try to break himself and the world up, so that all seems to correspond to his way of thinking. Man thus obtains an apparent proof of the correctness of his fragmentary self-world view though, of course, he overlooks the fact that it is he himself, acting according to his mode of thought, who has brought about the fragmentation that now seems to have an autonomous existence, independent of his will and of his desire. (1980:3)

Clearly, there is a problem with fragmentation through language. The question is: Do we as linguists do anything about it? And if so, what ought we to do?

Such questions are proffered here not with any hope of an immediate answer. This is a matter of linguistic ethics that needs to be investigated, discussed, and provided ultimately with some well-informed policy proposals in the hope that someone willing to suspend the 'fragmentary self-world view' may listen.

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THE ENGLISH SIMULTANEITY NETWORK: THE CASE OF *AS* AND *WHILE*-CLAUSES

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ENGLISH CAN CODE SIMULTANEITY, i.e. total or partial temporal overlap, between two events by making use of various (simultaneity) markers (or connectors). Among them are *as*, *while* and *when*, as is shown in examples (1)a–b from Biber *et al.* 1999:

(1) a. An armed robber was mugged of his loot **as** he made his getaway. (BNC)
b. She said that the pain was a little better after the pethidine she had been given and she was able to rest quietly **while** she waited to be taken to theatre. (BNC)
c. **When** he was in the air force he flew Tornado jets. (LDCE)

Simultaneous (or temporal) *as* and *while*-clauses, in particular, are often compatible with additional interpretations (Biber *et al.* 1999:846–50). In addition to temporality, *as*-clauses can express causality, see (2)a, and *while*-clauses can convey a contrastive interpretation, see (2)b.

(2) a. She kept her head down **as** she spotted the newsmen. (BNC)
b. Schools in the north tend to be better equipped, **while** those in the south are relatively poor. (BNC)

Very little research has been carried out on simultaneity clauses in either English or other languages. Notable exceptions are Edgren 1971, Heinämäki 1978, Silva 1991, Morris 1996, and Declerck 1997 for English; see also Schmiedtová 2004 on the production of Czech simultaneity clauses by German and English learners. This paper aims to contribute to the study of the explicit coding of simultaneity in English by analysing and contrasting in some detail the behaviour of *as* and *while*-clauses. It shows that *as* and *while* simultaneity clauses tend to be used differently and attempts to account for this finding by postulating that only the connector *while* is specified as a default temporal marker in our mental lexicon.

1. DYNAMIC AND STATIVE EVENTS.[1] The most detailed treatment of *as*-clauses so far is also the most recent one, namely Morris (1996). She claims that an *as*-clause is interpreted temporally if and only if a multiphase event is evoked (see also Silva 1991 for a similar point). In a multiphase event, two successive configurations in time are different from each other. In other words, the term multiphase seems to be a synonym of the more current term dynamic. It follows that example (3), from Morris (1996), is correctly interpreted in temporal fashion since the event of growing implies change.

(3) As she grew older,...

By contrast, when no multiphase event is evoked, i.e. when a monophase event is depicted, allegedly only causality obtains. Since a monophase event is such that two successive configurations in time are identical to each other, the term monophase seems to correspond to the more common term stative. For example, since the events in the *as*-clauses in (4), from Morris (1996), are construed as being stative, causality is expected to obtain.

(4) a. As you are here...
b. As you know...
c. As he wore a red sweater...

In fact, it can easily be shown that temporal *as*-clauses do occur with monophase events. Verbs of posture (see (5)–(7)), verbs of watching (see (8)), verbs of keeping (see (8)) and verbs describing bodily states (see (9)) are all found in temporal *as*-clauses. Even the verb *wear* (cf. (4)c) and stative *be* (cf. (4)a) can appear in temporal *as*-clauses, see (10) and (11) respectively.

(5) The wind whips round us **as** we **stand** on the seafront. (Morrall 2003:281)

(6) He says it in a whisper, with his eyes upon her, **as** she **sits** at the window bent over her work. (Waters 2002:237)

(7) The company commander then moves in **as** Iman **lies** wounded and helpless. (*The Guardian*, 24.November 2004, p.2)

(8) The bottle of Sylvaner from the cellar was cool and sweet. It reminded him even more of Heidi. [...] Her slow smile **as** she **watched** him. The quivering strength of her grip **as** she **held** him to her. (Millar 2004:197).

(9) ...a day after eight blinging pieces of jewellery were snatched from his bedroom **as** he **slept** with his wife, Sharon, in their Buckinghamshire mansion. (*The Guardian*, 24.November 2004, p.3)

(10) He pictured her laying (sic) on her bed back then, he sitting beside her, rubbing her belly **as** she **wore** panties and a cut off sleep shirt. (http://www.novelguides.com/ClassicNotes/Titles/wutheringheights/wwwboard/messages/2123.html)

(11) My pager went off **as** I **was** on the train on Nov. 3. (http://www.suntimes.com/special_sections/ transplant/cst-nws-liverone26.html)

It is debatable, however, whether (11) contains a truly stative *as*-clause. One could argue that the predicate *be on the train* refers metonymically to a motion event, hence a dynamic event. Admittedly, no unambiguously stative examples with the copular verb *be* have been found in the texts analysed for this paper. The other examples I came across, i.e. (12)–(14), all hint at change. In (12), *less and less* evokes dynamicity; the *as*-event in (13) describes a point along a path which is being traversed; (14) contains the participial *preparing* immediately after the stative predicate *be crouched*, thus pointing at impending change.[2]

(12) When items are arranged in this way, most of the 1s will appear as a peak at the bottom of the scale and there will be a gradual decrease in frequency **as** the attributes **are** less and less possible in human performance. (Hatch & Lazaraton 1991:204)
(13) That made me pause **as** I **was** halfway across the building's front plaza. (Connelly 2003:80)
(14) **As** I **was** crouched, preparing myself for a quick raid on the locker, a series of waves got me thinking. (Martel 2002:169)

In sum, monophase *as*-events are compatible with temporal readings (*contra* Morris 1996, Silva 1991) although no truly stative *be* examples have been found in *as*-clauses. These facts are explored further in the next two sections.

2. *AS* VS. *WHILE*-CLAUSES. It is a truism that both *as* and *while*-clauses refer to temporary configurations, hence the impossibility of (15)a with a temporal interpretation, since knowledge is usually regarded as a relatively permanent state. Nevertheless, the contrast in (15)b remains to be accounted for.

(15) a. {*As/*While} you know...
b. {*As/While} you are here...

In order to tackle this problem, it is useful to investigate the behaviour of *as* and *while*-clauses in more detail by relying on authentic data. I first conducted a preliminary investigation using the first 443 of the total 833 pages of Faber's (2003) novel *The Crimson Petal and the White*. It emerged that temporal *as*-clauses are more frequent than temporal *while*-clauses (255 vs. 64). Further, *while*-clauses occur in contexts where either a (relatively) long action is evoked or states/properties, expressed through the verb *be* (or a modal verb), are profiled. Some representative examples are provided in (16)–(19).

(16) 'Besides, I occupied myself quite usefully **while** I **was waiting**'. (p.117)
(17) Instead, he eats his sausage **while** it'**s** still warm. (p.133)
(18) 'Because I must do *something* **while** I still **can**'. (p.182)
(19) Nor, **while we're** on the subject of her disadvantages, does she consider herself ugly. (p.209)

These findings were later checked against authentic data obtained from the BNCWeb (*http://escorp.unizh.ch*). The data were retrieved using the BNCWeb Query System. Two text types were chosen, namely imaginative written and leisure spoken, so as to collect examples from two (potentially) opposite types along the written-spoken continuum. The leisure subcorpus contained a total of 241 instances of *while* tagged as a CJS (= subordinating conjunction). An identical number of examples of *while* as a CJS was randomly selected from the imaginative written subcorpus. Similarly, in the case of *as* as a CJS, 241 examples were randomly selected from each of the subcorpora. Of course, not all *as* and *while*-clauses thus

obtained were simultaneity clauses, since some examples conveyed causality or contrast only. Therefore, the data had to be inspected manually so as to discard non-temporal examples.

The results can be summarised as follows (see the Appendix for a more detailed breakdown of the data). In the case of *while*-clauses in the 'imaginative written' subcorpus, dynamic verbs par excellence, i.e. verbs of change (of position/state), account for only 21% of the data. In more detail, change-of-position verbs are much more frequent than change of state verbs, accounting for 17% of all data (i.e. 84% of all change verb cases). Importantly, only about 14% of change-of-position verbs have a subject which is identical to that of the main clause. This figure (here as well as in the statistics below) also includes cases where the relation between the subject of the temporal clause and the subject of the main clause is a part-whole one (this would be the case of sentences like *While they were talking, she was thinking that...*, where *she* refers to a person who is part of the group of people denoted by *they*). More generally, even considering *while –ing* cases (e.g. *while driving, she...*), only about 21% of the *while*-examples have the same subject in the *while*-clause as in the main clause.

The overall picture differs greatly when one considers *as*-clauses in the imaginative written subcorpus. First, only one *as*-example out of a total of a hundred was found that contains the verb *be*. By contrast, *be* examples account for 19.5% of the written *while*-data (which also include three negative examples, a pattern never found in the *as*-data). Further, the only *as*-example with *be* is actually a pseudo-progressive construction, i.e. *as [she] was there standing*. In other words, it cannot be taken as a genuine stative example on a par with *while she was there* (see (14)). The second important point concerning the behaviour of *as*-clauses is the fact that change verbs account for 72% of the data. Change-of-position verbs alone account for 62% of the data and in almost 50% of such cases the subject in the *as*-clause is the same as the subject in the main clause. More generally, in 54% of all *as*-examples the subject in the *as*-clause is the same as the subject in the main clause.

Moving on to the spoken data, one observes less lexical variability in both *as*-clauses and *while*-clauses, as might easily be expected. Despite this, the tendencies outlined for the written data hold good for the spoken data as well. In the case of *while*-clauses, the use of the verb *be* is much more frequent in the spoken language than in the written language (46.6% vs. 19.1%). By contrast, the use of change verbs is approximately constant (19.9% in the spoken subcorpus vs. 19.1% in the written subcorpus). The percentage of same-subject cases is higher than in the written data, amounting to 34% (also including three *while -ing* cases). This may be due to the higher percentage of *be* examples, which can often be used to introduce a temporal frame within which events involving the subject of the *while*-clause are narrated (e.g. *What were <u>you</u> keeping watch for **while** <u>you</u> were on board?*).

As-clauses greatly differ from *while*-clauses in the spoken language as well as the written language. The percentage of change verbs in *as*-clauses is even higher than in the written language, amounting to 86%. One fourth of them are change-of-state verbs and most change-of-place verbs (11 tokens out of 18) are instances of *go*. Finally, the percentage of same-subject cases is higher than in the written data, amounting to 63%.

It can be concluded that the behaviour of *as* and *while*-clauses remains roughly constant in the two text types examined. The data show that *as*-clauses often involve change verbs (especially in the spoken language), which might explain why previous analyses such as

Morris (1996) stress that *as*-events must be dynamic. It should be remembered, however, that stative verbs are also possible (see section 1). By contrast, *while*-clauses do not show any strong preference for change verbs. They seem to evoke more stable configurations (especially in the spoken language, where *be* instances account for almost 48% of the data). This confirms the tendencies observed in Faber's novel. Further, *as*-clauses show a stronger preference for subject identity, i.e. the subject of the main clause is often either the same as that of the temporal *as*-clause or is linked to it by a part-whole relation. This finding represents textual support for Silva's (1991) intuition that the degree of conceptual integration between an *as*-event and its main clause event is stronger than that between a *while*-event and its main clause event. Finally, the main difference between the two text types considered in this analysis is that both *as* and *while*-clauses exhibit less lexical variability in the spoken language.

3. DIFFERENT LEXICAL ENTRIES. The greater flexibility of *while*-clauses in comparison to *as*-clauses is illustrated in (20)–(22). Only *while*-clauses seem to be compatible with truly stative *be*, modal verbs and negation:

(20) Instead, he eats his sausage **{while/*as}** it's still warm. (Faber, p.133)
(21) 'Because I must do *something* **{while/*as}** I still **can**. [...]' (Faber, p.182)
(22) Fat lot of use I'd be to any girl **{while/*as}** I **don't** have a job. (BNC:FRR 572)

Again, the asterisk indicates that these sentences cannot be understood with a temporal meaning, not that they are ungrammatical per se. I contend that these facts can be accounted for by invoking a lexical semantic solution. The hypothesis I would like to advance here is that the lexical item *while* evokes temporality (i.e. susceptibility to change in the sense of Williams 2002) on its own (cf. also the temporal noun *while* in phrases like *in a while*). By contrast, the lexical item *as* is unspecified for temporality (since it has a wider inventory of uses than *while*, including comparative, causal and parenthetical uses). In other words, a temporal interpretation is assumed by default in the case of *while*-clauses whereas it is evoked constructionally in the case of *as*-clauses. Since *be warm*, *can* and *not to have a job* do not obviously contribute any temporal exponent to their respective *as*-constructions (i.e. they do not refer to events with a high degree of susceptibility to change), a temporal meaning cannot be retrieved for the *as*-constructions in question. This line of reasoning for the contrast in (20) is represented in the hopefully self-explanatory schema in (23).

(23)	*temporality*	*temporality*		
	a. as	it is warm		
	[unspecified]	[stative]	→	temporality cannot be retrieved
	b. while	it is warm		
	[+temporal]	[stative]	→	temporality can be retrieved

An apparent problem for the present analysis is the occurrence of stative verbs (e.g. verbs of posture, see (5)–(7)) in *as*-clauses. Since *as* does not contribute a temporal exponent on its own,

in what sense can we say that the corresponding *as*-clause evokes temporality? My contention is that verbs like *sit*, *stand*, and *lie* evoke a high degree of susceptibility to change when they are predicated of animate referents. Since they can describe activities performed by animate entities and since change is intimately connected to animacy, it is easy to conceptualise the events evoked by such verbs as pointing to unstable equilibrium states, that is a high potential for change. *Sit*, *stand* and *lie* describe temporary states in our daily routine, in which we move from one to the other(s) frequently and/or repeatedly. Moreover, in context, (5)–(7) are precisely temporary, relative to the surrounding narrative. A similar analysis can easily be extended to other verb types, such as verbs of watching, keeping and bodily states in that they all depict temporary configurations. In sum, I will say that *as*-clauses construe **path events**, i.e. events with a high degree of susceptibility to change.

4. CONCLUSION. This paper has shown that *as* and *while*-clauses tend to be used differently, despite what is commonly reported in English dictionaries. For example, the *Longman Dictionary of Contemporary English* (CD-Version) glosses temporal *as* as '*while* or *when*'. Interestingly, however, all three illustrative examples provided in the dictionary, see (24), contain change verbs (i.e. *get off*, *pass*, *leave*).

(24) a. I saw Peter **as** I was getting off the bus.
b. **As** time passed, things seemed to get worse.
c. Just **as** the two men were leaving, a message arrived.

This accords with the finding that *as*-clauses code path events, especially change events (i.e. events evoked by change verbs).

Unlike *while*-clauses, *as*-clauses are not compatible with stative *be*, modals or negated VPs because temporality could not otherwise be retrieved. *While* is regarded as a default temporal subordinator; it can combine with a wider range of verb types since temporality can always be retrieved. By contrast, *as* has been analysed as being unspecified for temporality in our mental lexicon. Further, since change verbs are not specific to *while*-clauses, *while*-clauses can be regarded as being more stative than *as*-clauses.

In sum, we can view *as* and *while*-clauses as defining a simultaneity network. They are obviously related to each other in that they both can code simultaneity but they construe simultaneous events differently by focussing on either susceptibility to change (*as*-clauses) or (relative) permanence (*while*-clauses).

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1 As is pointed out by a reviewer, some linguists may object to the use of the phrase 'stative event' because they consider 'events' as dynamic by definition. Here I use the term 'event' in a more general sense (see also Morris 1996 and the use of the similar term 'process' in Langacker 1987).

2 I analyse *crouched* as an adjective. If *be crouched* is analysed as a passive, then (14) is not an example of static *be* (but of the verb *crouch* in the passive). In other words, (14) is, in either case, debatable as a genuine instantiation of static *be*.

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APPENDIX

Only the first verb has been counted in coordination cases. If a verb occurs more than once, this is indicated explicitly (by giving the total number of occurrences in parentheses). Negative cases, for the sake of analytical convenience, have exceptionally been grouped under NOT in OTHER VERBS.

While-clauses in the written imaginative subcorpus:

CHANGE OF POSITION (31 tokens, 17.4%)

approach, bend, back out, be sent, bring down, carry, collect, crawl, dance, fall, feel my way along, fetch (2), flit, go to + infinitive (2), go try, hurtle off, jump down and open, meander towards him, open and shut, perambulate, put on (2), put the washing out, scout, slip off, step forward, sway back and forth, take out, walk

CHANGE OF STATE (6 tokens, 3.4%)

boil dry... burn to a crisp, change, grow up, achieve his deepest wish, secure the devices

BE (34 tokens, 19.1%)

be + away, like this, on the Commons, up, a slave to, absent, alive, at it (2), at school, away (3), black, busy provoking each other, free, gone, good, here, hot (2), in bed, in desertion, in hospital, in prison, like that, on, out, out working, there (3), turned, under the same roof

OTHER VERBS (107 tokens, 60.1%)

ask (2), await, beam, call, can (2), carry on, cast, clean, cook (2), cope, deal with, decide, discuss, do (6), drink, dwell upon, eat (2), endure, examine, explore, feel for, fight about, give, go ahead making their preparations, go on, go shopping [change of position classification also possible], gorge yourself, grin, haunt, have visions of, help, hold (4), indulge, iron, last, look, look round for, lose herself (in a book), make (2), make the game, **NOT** (3) (be here, have a job, move), play (5), present oneself as, read, recall, regain, remain (2), rest (2), rub, sing, sit (2), sleep (2), sort (things) out, speak (2), stand (5), stare, stay (3), subdue, swallow, talk (4), tell, trample, translate, try to catch, wait (4), wash, watch (2), weave and prepare food, work (3), write

_As_-clauses in the written imaginative subcorpus:

CHANGE OF PLACE (62 tokens, 62%)

approach (2), come (2), cross the room and leave, crumble back into the clay, curl, draw (2), drift in and out, drive (3), fetch, get into the car, give the canoe a push, go (3), guide, kneel down and start to dust, lean to retrieve, leave (2), lift (2), move in and out, pace, pass (2), pick it up, pull (2), put down her basket and take off her shawl, raise, reach, return, rise (2), set the glass down, sift through, slide her hands down and smooth them over the... swell of his hips, slip (2), sneak in, snuggle closer to him, spatter, spit out, spread the hake, stop the jeep, take (2), thumb through the ledger and take out, thump into, tilt to catch the sunlight of space, trample behind the horses, tread, turn, unfold, unwrap, walk (2)

CHANGE OF STATE (10 tokens, 10%)

become aroused, close (2), end, finish with, get better, go on (2), prepare for, start the car and move away

***STATIVE* (14 tokens, 14%)**
be there standing, clasp, cling tightly, contemplate, have, hold her and kiss her lips, lie in life-support, look (2), sit with a whisky and wait for, smile, stand, stare, watch

***OTHER VERBS* (14 tokens, 14%)**
absorb (2), caress (2), clean away the dishes, count, feel the water beneath me slop and gurgle, frisk me for weapons, let herself out into the garden, read, realise, ring off, strike, work

***While*-clauses in the written leisure subcorpus:**

***BE/CAN* (61 tokens, 46.6%)**
be +NP/AP/PP (59), can (2)

***CHANGE OF POSITION* (20 tokens, 15.3%)**
carry him to pit bottom, chase, collect, come, come ashore, cross to safety, fold this net up, follow, get round the chair, go (8), pour, progress, take

***CHANGE OF STATE* (6 tokens, 4.6%)**
chop, get it erected, get used to, hot, raise prices, turn off the television

***OTHER VERBS* (44 tokens, 33.6%)**
camp in, continue, do (4), eat, enjoy, get a ticket, have (7), lie, look, look after, make, mend, negotiate, promote, protect and preserve, say, seem impotent and indecisive, serve as a detective, set new standards, shoot and kill, sign, talk (5), test, wait, watch, work (6)

***As*-clauses in the written leisure subcorpus:**

***CHANGE OF STATE* (6 tokens, 21.4%)**
be sworn in, become, get older (2), grow older, run out of processing power

***CHANGE OF PLACE* (18 tokens, 64.3%)**
come home, enter, go (11), hand, leave Downing Street, move, pop it off, take the big piece out

***OTHER VERBS* (4 tokens, 14.3%)**
hit, plough, stay still

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SWITCH-REFERENCE IN HIDATSA: PAST AND PRESENT

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This paper[1] examines the change that has occurred with regard to the role of several morphemes in Hidatsa, a member of the Siouan language family. This change has taken place over the last 100 years and can be traced through the few texts that have been written in Hidatsa. Historically, the morphemes in question function as both a switch-reference (SR) system, where inflectional clause final suffixes on the verb track subject continuity between clauses, and a temporal/conditional clause connective system. This system is further complicated because Hidatsa had two different registers of speech in which these SR/clause final markers functioned differently. The two registers in Hidatsa are a common register used in everyday speech and a more elevated narrative register that was used in the telling of traditional stories.

By using the few texts that have been collected in Hidatsa over the last 100 years, in addition to recent fieldwork, we can trace the developments that have taken place with regard to the SR and clause connective system. Using these texts, I show how the SR and clause connective system worked in both registers of speech; detail how the SR portion of this system has collapsed and been reanalyzed to form a coordinate system that patterns along the lines of English. Finally, I postulate a possible explanation as to how this change happened and provide an explanation for how the two registers of speech may have arisen in Hidatsa from the gender systems found in the other Siouan languages and postulated for Proto-Siouan.

1. Written Hidatsa texts. There are ten texts that have been written and published in the Hidatsa language.[2] All but one of these published stories are known as *maášii*. These are traditional stories that tell of the creation of the world, the origins of the various clans, and moralistic and humorous stories (often involving the character Old Man Coyote or First Worker). These are all told in the narrative register. These stories are considered holy and the Hidatsa do not like to tell them to outsiders. Out of respect for the Hidatsa people I quote sparingly from them. These stories could (and can) be told by either men or women, although they were (and still are) only told by elders who know the full story in its correct form. The one story that is not a *maášii* was told to Zellig Harris and C. F. Voegelin in 1938 (Lowie 1939). It is the story of how the Waterbuster Clan retrieved their sacred bundle from the Museum of the American Indian.[3] This story is told in the conversational register. The most salient features in these different registers of speech are the sentence final illocutionary markers. In the traditional narrative, the sentence final marker is *-wareec* 'they say' indicating knowledge that has been handed down through the generations. As is shown below, these are the only two morphemes to remain constant in their use. In the

Text name & date of recording	Speaker information	Reference
1. First Worker intrudes on Sun's realm (1911)	Unknown	Lowie 1939
2. First Worker captures geese (1911)	Unknown	Lowie 1939
3. First Worker captures prairie dogs (1911)	Unknown	Lowie 1939
4. The girl who became a bear (1911)	Unknown	Lowie 1939
5. The Waterbuster account (1938)	Unknown	Lowie 1939
6. Packs Antelope (1977)	Female, mid 50s	Parks *et al.* 1978
7. The return of Wolf Woman (1977)	Female, late 60s	Parks *et al.* 1978
8. Lone Man and First Worker make the world	Male, early 70s	Parks *et al.* 1978
9. Old Man Coyote and the rock (1977)	Male, early 70s	Parks *et al.* 1978
10. Coyote Chief and the two blind men (1978)	Female, late 60s	Wicker 1978

Table 1. *The Hidatsa texts and speaker information.*

conversational register, there are a variety of sentence final markers (H. Matthews 1965, Boyle 2001), but the most common is the simple declarative *-c*. The names of the ten texts and speaker information are shown in **Table 1**.

2. SWITCH-REFERENCE. Hidatsa is an SOV language almost exclusively spoken on the Fort Berthold Indian Reservation in North Dakota.[4] Like many Native American languages it has no overt third-person pronominals. Switch-reference is a device for referential tracking where one of a set of morphemes is affixed (usually suffixed) to a verb in order to indicate something about the identity of a noun phrase (Haiman & Munro 1983: ix). These markers help track the identity of a subject from one clause to the immediately following clause. In Hidatsa, these morphemes are suffixed onto the clause-final, but not matrix-final verb.[5] The switch-reference morphemes in the narrative register are *-ak* (same subject, henceforth SS) and *-ruk* (different subject, henceforth DS). In the conversational register they are *-ak* (SS) and *-wa* (DS). An example of the system in the narrative register can be seen in examples (1)–(4):

(1)	'ráap	kúaru	awáak'	háaʔaruk	awáakiwareec
	'ráapa[6]	kúa-ru	awáaka'	hée[7]-ʔa-**ruk**	awáaki-wareec
	'pass.by.(IMPER[8])	DEM-LOC	sit.(IMPER)'	say-PL.D-**DS**	sit-NE

'Pass by over here! Sit down!' they said. He (First Worker) sat down. (Lowie 1939:I-38)[9]

(2)	ha**rúk**	ruš^{h}íhawahku**ruk**	cíitapušiš	karáa**ak**	réewareec
	ha**rúk**	ruš^{h}ih-awahku-**ruk**	cíitapušiš	karáa-**ak**	rée-wareec
	SC	twitch-there-DS	Spotted Tail	run-SS	go-NE

Then when (First Worker) twitched, Spotted Tail ran away again (they say). (Lowie 1939:III-34)

(3)

ha**rúk**	ra**ak**	ixpašée	áraxeex**ak**	aʔak^{h}ú**ak**	wirawahúka
ha**rúk**	ree-**ak**	ixpa -šée	áraxeexi-**ak**	aʔak^{h}ú-**ak**	wira-wahúka
SC	go-SS	wing-by	hold-SS	bring-SS	woods-inside

aʔakrúuceep**ak**	réewareec
aʔak-rúu-ceepi-**ak**	rée-wareec
carrying-in-have-SS	go -NE

Then holding him (the goose chief) by the wing, he (First Worker) carried him inside the woods, (they say). (Lowie 1939:II-5)

(4)

ha**rúk**	ákcixi**ruk**	kará**ak**	réewareec
ha**rúk**	ákcixi-**ruk**	karáa-**ak**	rée-wareec
SC	jump-DS	run-SS	go-NE

Then (First Worker) jumped, and (Spotted Tail) ran away (they say). (Lowie 1939: II-37)

In example (1) we see characters giving an order and then the subject switches and the character receiving the order sits down. In example (2) the initial subject is understood from the previous sentence but it switches in the second clause. In example (3) there is a series of clauses with the same subject, although no overt subject is expressed. Lastly, in example (4) there is no overt subject expressed, but speakers know the subject has changed due to the SR morphology.

The SR system works in a similar manner in the conversational register of speech. This can be seen in example (5):

(5)

kiruwác^{h}ihkaak	úuwaca	wahkirakap^{h}ák	watawaaʔaahtúuʔaš
ki-ruwác^{h}i-hkee-**ak**	úuwaca	wah-kirakap^{h}á-**ak**	watawaaʔaahtúuʔaš
us-as.one-CAUS.I-**SS**	money	IA-collect-**SS**	our.skulls

wahkuuciwaawáahak	wiihiirahpáʔawa	ruxpáaka	iháhtaari
wah-kuuci-waa-wá-aha-**ak**	wii-hiirahpá-ʔa-**wa**	ruxpáaka	iháhtaa-ri
IA-get-INDEF-IA-want-**SS**	IB[10]-difficult-PL.D-**DS**	people	other-FOC

wiikuxtáapak	waaʔooriš^{h}íhirak	waarúušaak
wii-kuxtí-aapa-**ak**	waa-aru-riš^{h}í-hiri-**ak**	waa-rúu-šaa-**ak**
IB-help-PL.C-**SS**	INDEF-PART-dance-make-**SS**	INDEF-INh-leave.alone-**SS**

uuwaca	kirakap^{h}ák
uuwaca	kirakap^{h}á-**ak**
money	collect-**SS**

We gathered together; we collected money; we wanted to get our skulls; it was difficult for us; the people of the other clans helped us; they had dances; they collected money. (Lowie 1939:IV-4)

In this sentence, the initial subject is 'us', which refers to the Waterbuster Clan. It then changes to 'people of the other clans'. This change is signaled by the DS marker *-wa*. The new subject is also marked with the focus marker *-ri*, which indicates new information in the discourse.

As can be seen, the SR morphemes act like a canonical SR system, tracking subject continuity between clauses in both registers of speech. This is a simple and elegant system, so it is natural to question how it would have broken down and been reinterpreted by younger speakers. The answer lies in the fact that these morphemes have several different functions within Hidatsa grammar and this muddies the picture considerably.

3. OTHER FUNCTIONS OF THE SWITCH-REFERENCE MARKERS. The SR markers have several other functions in Hidatsa. These vary depending upon the register of speech. The morpheme *-ruk* can also serve as a conditional clause marker in both the narrative register of speech, as shown in (6):

(6)	haruk^{h}í	waahkuwiríš	šeʔerú	akiwahkúwareec
	haruk-hí	waahku-wirí-š	šeʔe-rú	aki-wahkú-wareec
	SC-CONJ	Nightlike-Sun-DET.D	DEM-LOC	with.others-stay-NE

waacakíhišeruk	itacak^{h}éewareec
waa-cakí-hiše-**ruk**	itacak^{h}ée-wareec
INDEF-good-have-**COND**	like-NE

And then Moon decided to stay with them. **Since** he (Sun) was having such a good time, he (Moon) found he liked it also. (Lowie 1939:I-76)

and the conversational register of speech, as shown in (7):

(7)	'táheeruk	aruʔišíac'
	'tá-hee-**ruk**	aru-išía-c'
	'die-CAS.D-**COND**	FUT-bad -DECL'

'**If** he kills him, it will be bad.' (Lowie 1939:I-49)

Although example (7) is taken from one of the traditional narrative texts, it occurs in a spoken dialogue by one of the characters. Speech between characters in the traditional narratives is always in the conversational register. Although the subject changes in both examples, the English glosses are conditional ones (i.e. cause and effect). The English translation in these cases is always rendered, not as an 'and' with a change in subject (as is expected if this morpheme is used as a DS marker), but as a 'since' or 'if' conditional clause. In addition, *-ruk* is not a DS marker in the conversational register, so that is clearly not its function in (7). It is functioning as a conditional marker.

Beside its function as a conditional marker, *-ruk* has several others. In example (8) *-ruk* functions as a temporal marker of contemporaneous action in the narrative register:

(8)

waapiwiríš	wat^{h}ee	rée**ruk**	íicihkawaahiriš	íhki	wat^{h}ee	éehkaa**k**
waapi-wiríš	wat^{h}ee	rée-**ruk**	íicihkawaahiriš	íhki	wat^{h}ee	éehkee-**ak**
Day-Sun	already	go-**TEMP**	First-Worker	himself	already	know-SS

iruuhíwareec
iruuhí-wareec
lift.up-NE

When the Day-Sun had already gone, First Worker himself, knowing now (how it's done), (he) stood up (they say). (Lowie 1939:I-10)

Although the subject changes in this example as well, this *-ruk* is a temporal morpheme co-occurring with *wat^{h}ee* 'already', as shown in the English gloss. In examples where *-ruk* is clearly a DS marker it is never translated as 'when'. Given the nature of these types of constructions, it is likely that the subject may change, but I assume that this is not a requirement since it is not a DS marker. The small amount of textual data provides no examples where the subject in these types of clauses does not change.[11]

In example (9) we see *-ruk* in the conversational register. In this example, it is clearly not a DS marker since it is in the conversational register. Here, it is a temporal marker of future action. This temporal notion is confirmed in the English gloss where we see the temporal word 'when'.

(9)

waaʔahtúuʔahe	xupáaʔawa	wiréeriruk	wireeʔúutiru	aruʔiiʔawáakic
waaʔaahtúaʔahe	xupáa-ʔa-**wa**	wiréeri-**ruk**	wiree-úuti -ru	aru-ii-awáaki-c
the skulls	holy-PL.D-**DS**	enter-**TEMP**	door-base-LOC	PART-INST-sit-DECL

The skulls are holy, **when** one enters, one should sit down by the door. (Lowie 1939:V-18)

Additional evidence showing the *-ruk* is not a DS marker in this sentence is the clear example of *-wa* being used as a DS marker. This is what is expected in the conversational register. There is also no change of subject between the clause ending in *-ruk* and the one that follows it. Here *-ruk* clearly marks a temporal future clause.

There is also evidence to suggest that *-ruk* serves this same function in the Narrative register. In example (10) there are two occurrences of *-ruk*.

(10)

'wiráapa	xíiriruk	arákaruk	rárahuric'	háaʔawareec
'wirá-aapa	xíiri-**ruk**	aráka-**ruk**	rá-rahu-ri-c'	hée -ʔa-wareec
'wood-leaf	brown-**TEMP**	2A.see-**TEMP**	2A-come-2.FUT-DECL'	say-PL.D-NE

'**When** the leaves turn brown, **when** you see them, you must come', they said. (Lowie 1939:I-86)

In this example, –*ruk* serves as a temporal marker. In the first clause, it functions as a future temporal marker, which is not a typical environment for the DS marker, although the subject does change. The second example is clearly not a DS marker since there is no subject

change between the second and third clauses. Again the English translation helps indicate its function as a temporal element, which is one that will take place in the future.

The morpheme *-wa* also has multiple functions in the texts collected by Lowie. In example (11), taken from a narrative text, *-wa* acts as an indefinite determiner.

(11)	ixú	xákaheet^{h}a	hiš^{h}áak	íitaki	ooraxpíwa
	i-xú	xák-heet^{h}a	hiš-hée-ak	íitaki	aru-raxpí-**wa**
	3.POSS.I-body	move-LOC	red-CAUS.D-SS	rabbit	PART-skin-**DET.I**

ap^{h}uhkahaak	itíikipi	kúraʔak	šeʔerúhaak	waapáahiwareec
ap^{h}úhka-hee-ak	ita-íikipi	kúreʔe-ak	šeʔerúha-ak	waa-páahi-wareec
hat-CAUS.D-SS	3.POSS.A-pipe	carry-SS	doing.thus-SS	INDEF-sing-NE

Reddening his body all over, using part of a rabbit skin as a hat, carrrying his pipe, thus, he (Day-Sun) sang. (Lowie 1939:I-5)

This is actually the most common function of *-wa* in the narrative register.

In the conversational register *-wa* also has several additional functions. It can function as an indefinite determiner and as a temporal marker of contemporaneous action, both of which are shown in (12):

(12)	áatawa	óokciawa	ahpáax^{h}i	árax^{h}aawa	hišaʔí	heʔešáak	xaréec
	áata-**wa**	óokcia-**wa**	ahpáax^{h}i	árax^{h}aa-**wa**	hiša-í	heʔešá-ak	xarée-c
	morning-**DET.I**	night-**DET.I**	clouds	burn-**TEMP**	red-until	SC-SS	rain-DECL

for a day and a night **when** the clouds burned red; and thereafter, it rained. (Lowie 1939:V-14)

The first two occurrences of *-wa* in (12) are clearly indefinite articles, as they are suffixed to nouns. The third occurrence of *-wa* is suffixed to a verb and here it serves as a temporal marker. Again this meaning is conveyed in the English translation.

This complex system of SR and temporal/conditional clause final markers that existed in Hidatsa when the Lowie texts were published in 1939 is shown in **Table 2**.

While this system seems quite complex, an almost exact duplicate exists in Crow (Graczyk 2006), the language most closely related to Hidatsa. According to Parks and Rankin (2001:104) the languages diverged from each other approximately 600 years ago and, while they are no longer mutually intelligible, they still share many similarities including two registers of speech and, as of 1939, a SR system.

4. THE SWITCH-REFERENCE AND CLAUSE CONNECTIVE SYSTEM THROUGH THE TWENTIETH CENTURY. In the five texts found in Lowie (1939), the system described above functions exactly as predicted. In 1911 and 1938, when the texts were recorded, Hidatsa still had a robust community of speakers, including many monolinguals. This is despite an incredible amount of hardship, including numerous smallpox epidemics, attempts to break up the traditional way of life, and forced schooling in Indian schools that consciously attempted to

	Conversational markers	Narrative markers
1) Same Subject	*-ak*	*-ak*
2) Different Subject	*-wa*	*-ruk*
3) Temporal Marker: Contemporaneous Action	*-wa*	*-ruk*
4) Temporal Marker: Future Action	*-ruk*	*-ruk*
5) Conditional Marker	*-ruk*	*-ruk*
6) Indefinite Article[12]	*-wa*	*-wa*
7) Sentence Final Marker	*-c*	*-wareec*

Table 2. *Hidatsa SR and clause connective system:* -ak, -ruk, *and* -wa.

stamp out native language use. Despite these hardships, communities of speakers remained intact. It was not until 1953, with the construction of the Garrison Dam, that these communities were fractured by the rising water which destroyed the traditional living places of the Hidatsa, who at this point were still living along the banks of the Missouri River.

The next group of Hidatsa texts published are Parks *et al.* (1978), which contains four stories told (or partially told) in the traditional narrative register and Wicker (1978), which includes one story, also told in the traditional narrative register. All of the stories contain dialogue, which one would expect to be in the conversational register. In these five stories there is clear evidence that the SR system is undergoing a change.

In the *Packs Antelope* text, the speaker is a woman in her mid 50's. She only uses the conversational DS SR marker *–wa,* not the expected *-ruk*. Examples of this are shown in (13) and (14).

(13)	aráaxic^{h}aaráaka	ita-áwašiš	máaruwa	íit^{h}ipiwa
	aráaxic-hee-ráaka	ita-áwaši-š	máa-ruwa	í-it^{h}ipi **-wa**
	ignorant-CAUS.D-SUBOR	3.POSS.A-eagle.trap-DET.D	INDEF-some	LOC-cover-**DS**

Before he knew what had happened, something had covered over his eagle trap.

(14)	áakaahta	pákišiwa	míʔihtéwa	šéʔri	íit^{h}ip^{h}eewareec.
	áakaa-hta	pákiši**-wa**	míʔi-ihtía-wa	šéʔ-ri	í-it^{h}ipi-hee-wareec
	top-GOAL	push-**DS**	stone-big -DET.I	DEM-TOP	LOC-cover-CAUS.D-NE

He pushed upwards against it, but a stone had covered him up. (Parks *et al.* 1978: PA-4–5)

Evidence that this story is in the traditional narrative register comes from the sentence final narrative ending *-wareec*. For this speaker, the morpheme *-ruk* is only used as a temporal or conditional marker. This speaker reflects the most extreme change that has occurred in the SR system although she is by no means alone.

The other two women recorded in the Parks *et al.* texts use the conversational DS marker *-wa* when we expect the *-ruk* marker, but not to the degree that the speaker who told the *Packs Antelope* story does. All of the speakers from this era use *-ruk* when we would expect it as a conditional marker, but this is not the case when it functions as a DS or a temporal marker. Clearly, this shows that the SR system is in a state of flux. The speakers are no longer in total command of this system.

The male speaker's SR system, from the Parks *et al.* texts, is also in flux. He clearly knows that the *-ruk* morpheme is used in the traditional narrative register and he does something very interesting. He hyper-corrects and uses the *-ruk* morpheme almost exclusively, including in conversational dialogue when we expect the *-wa* DS marker to be used. An example of this can be seen in (15) taken from the text *Lone Man and First Worker Create the World*.

(15)	'kúaruhaak	ríhki	awašitáhtaa	ráheeruk,	wíhki
	'kúa-ruha-ak	ríhki	awa-šitá-hta-a	rá-hee-**ruk**,	wíhki
	LOC-from-SS	2.PRO	land-north-GOAL-CONT	2A-CAUS.D-**DS**	1.PRO

úuwahtaa	wahéewic.'	'hóo'	háak
úuwa-hta-a	wa-hée-wi-c.'	'hóo'	háa-ak
south-GOAL-CONT	1A-CAUS.D-1.FUT-DECL	yes	say-SS

'From there you make the land to the north, and I will make that to the south', said Lone Man, and First Creator said, 'All right'. (Parks *et al.* 1978: LM & FW20)

These examples show us the SR system is beginning to break down and be reanalyzed. The SR system that existed in Hidatsa in the late 1970s is shown in **Table 3**. In this table, *-ruk* is now the morpheme used for all conditional clauses whereas both *-wa* and *-ruk* are used to mark temporal clauses. The DS markers are not used consistently in either register of speech for formal story telling.

5. MODERN HIDATSA SENTENCE CONNECTIVES. In modern Hidatsa the SR system is no longer present. Speakers have reanalyzed the markers into a pattern that is clearly reflective of English. The SS marker *-ak* has been reanalyzed as the coordinating conjunction *-k,* which was (and still is) used to conjoin nouns and noun phrases. This occurs even when the subjects of the clauses are different, as can be seen in (16).

(16)	awakawak	natiriac
	awakawa-**k**	na-tiria-c
	1A.walk -**COOR**	2A-run-DECL

I walked and you ran. (Boyle: 2003)

The marker *-wa* is now used to mark temporal clauses as shown in (17) and the marker *-ruk* is used to mark conditional clauses as shown in (18).

	Conversational markers	**Narrative markers**
1) Same Subject	*-ak*	*-ak*
2) Different Subject	*-wa/-ruk*	*-wa/-ruk*
3) Temporal Marker	*-wa/-ruk*	*-wa/-ruk*
4) Conditional Marker	*-ruk*	*-ruk*
5) Indefinite Article	*-wa*	*-wa*
6) Sentence Final Marker	*-c*	*-wareec*

Table 3. *Hidatsa SR system in the late 1970s:* -ak, -ruk, *and* -wa.

	Conversational markers	Narrative markers
1) Clause Coordinator	*-ak*	*-ak*
2) Temporal Marker	*-wa*	*-wa*
3) Conditional Marker	*-ruk*	*-ruk*
4) Indefinite Article	*-wa*	*-wa*
5) Sentence Final Marker	*-c*	*-wareec*

Table 4. *Modern Hidatsa system:* -ak, -ruk, *and* -wa.

(17) Alex ikáac mia reeʔawa
Alex ikáa-c mia reeʔa-**wa**
Alex see-DECL woman leave-**TEMP**
Alex saw when the woman left. (Boyle:2004)

(18) xaréeʔap^{h}uhka óowiat^{h}aa néešaruk niišíikiihta arukáreec
xaréeʔap^{h}uhka óowia-t^{h}aa néeša-**ruk** ni-šíikiihta aru-káree-c
rainbow point -NEG not-**COND** 2.POSS.I-finger PART-rot-DECL
Don't point at rainbows or your fingers will rot off. (Traditional Hidatsa saying)

The system that exists in modern Hidatsa with regard to the morphemes in question can be seen in **Table 4**. As this table shows, the SR system that existed in Hidatsa is no longer present. It has been reanalyzed and a leveling has taken place with regards to the two registers. The only difference between the two registers that exists today is in the sentence final marker, which is the most salient feature of the traditional narrative structure.

6. A POSSIBLE EXPLANATION OF THE TRADITIONAL NARRATIVE AND CONVERSATIONAL REGISTERS. There is, of course, no way of knowing how the two registers of speech first developed. We know that they existed before the Hidatsa and Crow split, as the two registers share the same morphemes and function in a near-identical manner[13] in both languages. Randolph Graczyk (personal communication) has suggested an intriguing possibility as to how these two registers of speech may have arisen and I believe it is worth

examining. All of the other languages in the Siouan family have gender markers that are sentence or clause final. These markers mark either the gender of the speaker, as has been shown in Lakhota (Trechter 1995) or the gender of the addressee, as shown in Mandan (Mixco 1997). The only languages within the Siouan language family that do not have this gender split are Hidatsa and Crow (Missouri Valley). Hidatsa and Crow are also the only languages that have two distinct registers of speech that are so grammaticalized in their morphology. It seems plausible that the two registers evolved from the gender markers that are posited to have existed in Proto-Siouan, with those found in the narrative register being the male speech markers and those found in the conversational register being the female speech markers. Although either men or women are culturally permitted to tell the *maášii*, it is more common for men to be the storytellers. As a result, I believe that the narrative register is a reflection of stylized male speech. This split becomes systematized in the SR and conditional/temporal system that existed in Hidatsa and is still found in Crow.[14]

7. CONCLUSION. What I have attempted to show in this paper is an example of language change. I have shown how a SR system existed in two different registers of speech in Hidatsa. Over the last 75 years, this system has undergone drastic change, reanalysis, and leveling to give us the clause connecting system found today in the modern language.

1 I would like to thank all of the LACUS conference participants who offered comments and encouragement regarding this paper. I would also like to thank the LACUS reviewers for their insightful comments as well as Randy Graczyk who also offered a number of comments on this paper in its various manifestations. A revised version of this paper is to appear in the *International Journal of American Linguistics* (IJAL).

2 The first person to publish scholarly work on Hidatsa was Washington Matthews (1877). Any texts that he recorded were destroyed along with all of his field notes in a fire in the late 1880s. Charles Hall (1898) wrote a short version of 'Packs Antelope' (a longer version is found in Parks *et al*. 1978). This text has never been published but a copy exists in the North Dakota Historical Society in Bismarck ND. Although the SR system is clearly evident, Hall did not distinguish vowel length or aspiration, so its value is limited. Jones (1977) recorded an additional text 'Rusty Tipi and the Hidatsa Land Claim'. The speaker of this text is a 67 year old woman and her speech patterns along the lines of the 'Packs Antelope' speaker detailed in Section 4. Since this text is not in general circulation it has not been used here. The material I have recorded, while not published, comes under the heading of 'Recent Field Work'.

3 The Waterbuster Bundle was purchased in 1907 by Gilbert Wilson, for the Museum of the American Indian in New York. In 1938 it was repatriated to the Waterbuster clan.

4 The Hidatsa have traditionally lived along the riverbanks of the Knife and Missouri Rivers.

5 Since Hidatsa is an SOV language the matrix verb comes at the end of the sentence. These matrix-final verbs do not take switch-reference markers. The switch-reference markers attach only to the clause-final verbs and indicate whether the subject of the clause that follows it has an identical subject (SS) or a different subject (DS). Matrix-final verbs take only illocutionary markers.

6 Under normal circumstances all Hidatsa verbs end in a vowel. The imperative in the Hidatsa conversational style is shown by a root final vowel deletion.

7 There are a number of phonological rules that 1) change vowel quality and length, 2) insert an epenthetic glottal stop between vowels at morpheme boundaries and 3) reduce certain morphemes before /r/ and /k/. In the second line of each example, I give the underlying representation of each morpheme with the exception of the epenthetic glottal.

8 Abbreviations for the glosses are as follows:

1A	first person active	DET.D	determiner: definite
1B	first person stative	DET.I	determiner: indefinite
1.FUT	first person future	DS	different subject
1.PRO	first person independent pronoun	FOC	focus
2A	second person active	FUT	future
2.FUT	second person future	GOAL	goal
2.POSS.I	second person possessive: inalienable	IMPER	imperative
		INDEF	indefinite
2.PRO	second person independent pronoun	INh	instrumental by hand
		INST	instrumental
3.POSS.A	third person possessive: alienable	LOC	locative
3.POSS.I	third person possessive: inalienable	NE	narrative ending
CAUS.D	causative: direct	PART	partitive
CAUS.I	causative: indirect	PL.C	plural: collective
COND	conditional	PL.D	plural: definite
CONJ	conjunction	SC	sentence connective
CONT	continuative	SS	same subject
COOR	coordinator	SUBOR	subordinator
DECL	declarative	SUUS	possessive reflexive
DEM	demonstrative	TEMP	temporal

9 This is a reference number for the text and line where the example was found. The first number corresponds with the text number and the second number corresponds to the line number in the text.

10 Hidatsa is an active/stative language. It should be noted here that 1A and 1B pronouns are pronouns that attach to active and stative verbs respectively. The appearance of the stative 1st person pronoun *wii-* in no way indicates a change of subject in this line.

11 Since no examples of *-ruk* marker as a conditional marker exist in the Hidatsa texts without a change in subject, the argument presented here is unfortunately a weak one. However, if we examine the parallel system found in Crow, we do find examples of the cognate *-dak* used as a conditional morpheme where the subject of the two clauses remains the same (Graczyk, personal communication). So although there is no direct evidence of my claim in the Hidatsa texts, a comparative examination of Missouri Valley Siouan, does support it.

12 The indefinite article *-wa*, is not truly a 'clause final' marker since it attaches to NPs. However, it can be used to nominalize clauses (i.e. relative clauses). This overlap between verbal and nominal morphology is found throughout the Siouan language family.

[13] It is interesting to note that Karen Wallace's dissertation on Crow (1993) found no sign of a SR system. She worked with a younger Crow speaker who no longer lived on the reservation in Montana. This would suggest that these systems are easily misinterpreted and reanalyzed.

[14] It should be noted that very few (if any) speakers of Crow command the narrative style of speech today, although it can be clearly seen in older texts (Graczyk, personal communication).

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II

NETWORKS AND NEUROLINGUISTICS

AUTOMATING THE IMPORTATION OF LEXICAL INFORMATION INTO A RELATIONAL NETWORK

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THIS PAPER DISCUSSES the implementation of a lexical knowledge base on the basis of a conceptualization of the problem domain of linguistic information in terms of computational Relational Network Notation as proposed in Webster (2005). In particular, the focus here is on importing linguistic lemmas into the knowledge base as instances from WordNet 2.0.

Relational Network Notation (RNN) 'offers a simple yet powerful means for representing lexicogrammatical, semantic and sememic information'(Webster 2005). RNN is driven by Relational Network Theory (Lamb 2004) and incorporates developments in the theory which have been shown not only to describe but also to explain linguistic phenomena in a neurologically plausible manner.

RNN is used to represent lexical information in a knowledge base comprised of instances of lexical entries drawn from WordNet. WordNet is a lexical system whose design is inspired by psycholinguistic theories of human lexical memory. English words (lemmas) are organized into synonym sets (synsets), each representing one concept. There are different relations linking the synsets. This organization of lexical information provides a clear specification of lexical relations which makes it ideally suited to representation in RNN.

Frame Logic (FLogic), a database modeling language, is used to implement WordNet. FLogic allows a systematic concept hierarchy for the structural aspects of domain knowledge with various knowledge base modeling features such as object identity, inheritance, methods, axioms, etc. One can also apply axioms to draw inferences needed to compute new knowledge and relations, thus enlarging the database. FLogic WordNet (FWN) is constructed on the basis of the prolog implementation of WordNet2.0 (*http://www.cogsci.princeton.edu/2.0/*), consisting of over 200,000 lemmas with indications of their part-of-speech and lexical relations and other properties.

FWN, then, serves as a source for the automatic mapping of lemmas into RNN. The mapping involves the following steps: 1) unification of identical concepts, i.e. classes referring to the same concept should share the same object type, and 2) application of mapping axioms to populate the relational network with instances from FWN.

1. RELATIONAL NETWORK THEORY. Relational Network Theory (RNT) suggests a neurologically plausible organization of information applicable to both linguistic and non-linguistic information. RNT explains the access of linguistic information throughout multiple strata, from a phonemic stratum to a conceptual stratum. The linguistic information system is represented as a 'network of interrelationships' (Lamb 1999: *passim*). A

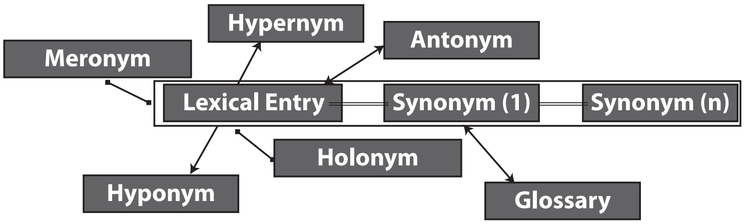

Figure 1. *Framework of WordNet.*

stimulus, or a sequence of stimuli (e.g. a string of phonemes), triggers a node in the network, activating corresponding pathways and the intersecting nodes, and consequently activating the lexeme and the corresponding sememe. Stimulation of a conceptual node can activate other conceptual nodes and connectivity is restricted in neither a bottom-up nor a top-down direction; thus lexemes can be activated by stimulation from both conceptual and phonemic nodes. Information is accessed in a bi-directional and stratum-independent manner.

2. RELATIONAL NETWORK NOTATION. The computational Relational Network Notation offers a simple solution for conceptualizing linguistic interrelationship based on Relational Network. Exploring a domain involving phonemic, lexemic, and sememic strata, RNN only requires the declaration of one class of objects—(node)—and one type of parameterized relation between nodes—(to@(threshold,identifier,{sequence})). As I implement RNN with FLogic, a small knowledge base can be enlarged under appropriate rules with the application of axioms.

In fact, this simple network schema is sufficient to represent both linguistic and nonlinguistic information without reference to objects. In RNT, linguistic information is realized through spreading activation along inter-connecting paths. Similarly, in RNN, details of linguistic information, such as phoneme, lexeme, and sememe, function as parameters (**identifiers**) in the relations between nodes.

3. WORDNET. WordNet is an online lexical reference system whose design is inspired by current psycholinguistic theories of human lexical memory. It was developed by the Cognitive Science Laboratory at Princeton University in 1985. English nouns, verbs, adjectives, and adverbs are organized into synonym sets (synsets), each representing one underlying lexical concept, a sememe. Between the synsets, there are different relations, such as antonym, hyponym, meronym, pertainym, entailment, etc. WordNet not only serves as a word-sense reference system but also as an English dictionary referring the usage of the language and the consensus of the interrelationship of English words according to its psycholinguistic basis. In WordNet, a lexical entry is referred to as a **lemma**, and its store of lexical concepts is referred as a **glossary**. **Figure 1** depicts a small portion of a WordNet synset with its general connections.

	Synsets	Glossary
1 (Noun)	father, male parent, begetter	a male parent (also used as a term of address to your father) …
2 (Noun)	forefather, father, sire	the founder of a family; …
3 (Noun)	Father, Padre	'Father' is a term of address for priests in some churches …
4 (Noun)	don, father	the head of an organized crime family
5 (Verb)	beget, engender, father, mother, sire, generate, bring forth…	make children; 'Abraham begot Isaac'; 'Men often father children but don't recognize them'

Table 1. *Synsets of father from WordNet 2.0.*

One method of instantiating RNN with lexical entries in WordNet is to convert the WordNet database into the formalism of RNN. FLogic WordNet is constructed for the express purpose of automatically importing lexical data from WordNet into RNN representation. Axioms are then employed to draw inferences and thus facilitate the mapping of WordNet data into RNN.

4. POPULATING LEXICAL DATA INTO RNN. In WordNet, a group of lemmas is included in a synset sharing an entry in the glossary of meaning. A synset is represented in RNN as a group of nodes. Each of them is associated with a lexeme, and these lexemic nodes are each connected to a sememic node, which is associated with a sememe. See **Table 1** for several synset examples with the word *father* from WordNet and **Figure 2** (overleaf) for these synsets in RNN representation.

Using the above mapping model, over 200,000 lemmas have been imported into RNN from WordNet.

Before enriching the RNN by importing lexical relations such as hypernyms or meronyms in WordNet, it is necessary to declare the appropriate schema governing the connections in the network. Although these connections are called **lexical relations**, the connection path for them in terms of RNT should run between sememic nodes rather than lexemic nodes. That is, access to such information is achieved through activation from sememe to sememe rather than from lexeme to lexeme.

Figure 3 (overleaf) shows the relational network between synsets with a hypernym relation in RNN representation. In **Figure 3**, a synset is represented as a group of nodes taking the same node as their sememic head-node. The single pathway connecting the sememic nodes or lexemic node denotes its associated sememe or lexeme respectively. Focusing on the sememic stratum, a sememic node connects to other sememic nodes through the relation of hyponym or hypernym. Such relations drawn from WordNet are therefore re-modeled into layers of connection between sememic nodes in RNN. It should be noted that each sememic node is also a representation of a WordNet synset. Activation of a sememe can be triggered via either a sememe or a lexeme.

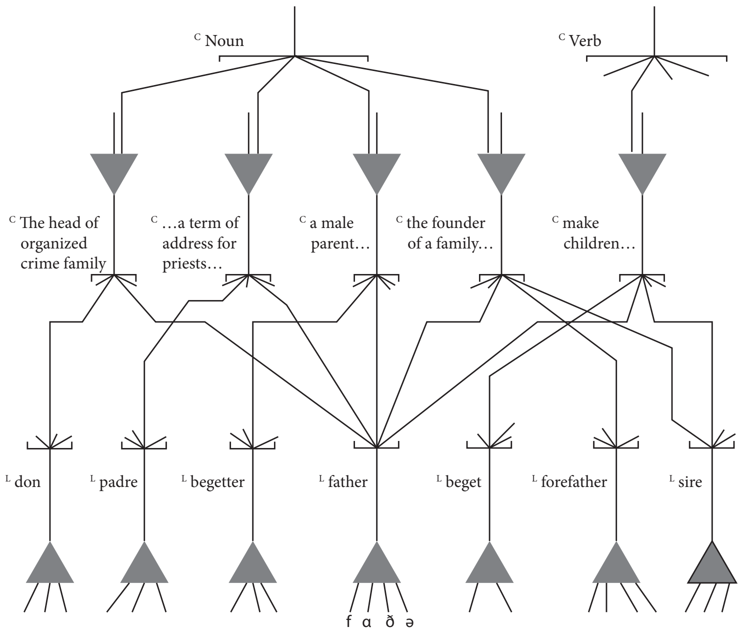

Figure 2. *'father' from WordNet in RNN representation.*

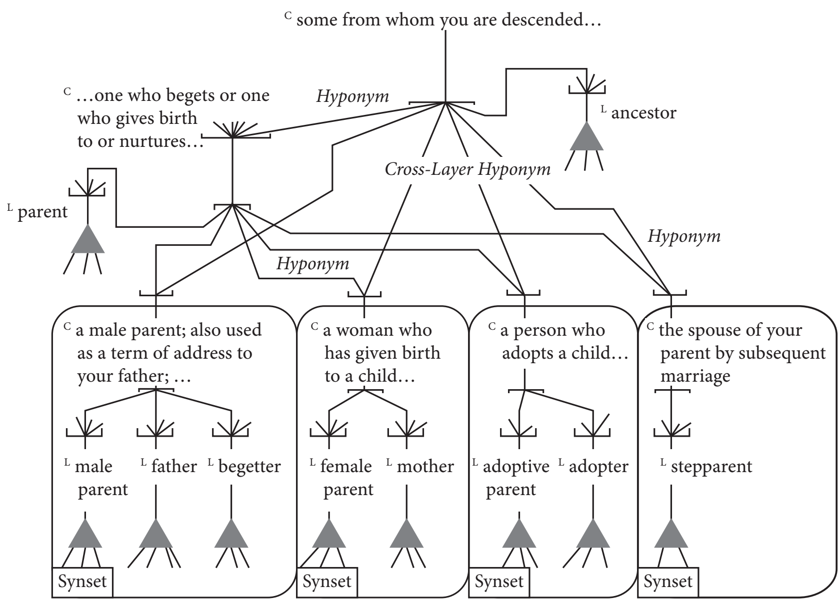

Figure 3. *Hyponym relation in RNN representation.*

5. MAPPING PROCESS. In WordNet, each synset carries an identity number; in the following FLogic source, a concept synsetId refers to a synset: it has offset, hasword, gloss, etc. as attributes. The following is the partial WordNet database for *father* in FLogic:

```
109434163:synsetId[hasword->>W1_109434163; hasword->>W2_109434163;
          offset->"o09434163"; pos->NOUN; ssType->NOUN;
          gloss->"a male parent (also used as a term of address to
          your father); \"his father was born in Atlanta\""].
W1_109434163:word[lemma->"father";      pos->NOUN].
W2_109434163:word[lemma->"begetter";    pos->NOUN].
FORALL S,Wd,L ( S:synsetId[haslemma->>L] ) <-
                ( S[hasword->>Wd] and Wd[lemma->L] ).
```

Four axioms were used to import the WordNet data into a RNN relational network:

```
(1)    FORALL X,Y Y:lexeme <- X:synsetId[haslemma->>Y].
(2)    FORALL X,Y Y:sememe <- X:synsetId[gloss->Y].
```

Axiom (1) creates lexeme from lemma and axiom (2) creates sememe from gloss. The next step is declaring the existence of **nodes** and their **connections**. The process uses the attributes lemma and offset of synsetId to name the nodes; the lexeme and sememe created are applied as identifiers in the relation …**to@[(threshold, identifier)->>…]**.

```
(3)    FORALL A,B,S,L,G,O A:node[to@(1,G)->>(B:node)] <-
            S:synsetId[offset->O; gloss->G; haslemma->>L] AND G:sememe
            AND concat("node_",O,A) AND concat("node_",L,B).
(4)    FORALL A,B,L,G B:node[to@(1,(L:lexeme))->>A] <-
            A:node[to@(1,G)->>B] AND G:sememe AND concat("node_",L,B).
```

Axiom (3) creates nodes (A) named with offset and nodes (B) named with lemma. Nodes (A) connect to nodes (B) via the identifier sememe.

Axiom (4) refers to the opposite direction of connection. i.e. that nodes (B) named with lemma connect to nodes (A) named with offset via the identifier lexeme.

With regard to the partial WordNet database for *father*, the axioms import to the RNN with

2 lexemes	:	'father' and 'begetter';
1 sememe	:	'a male parent…';
3 nodes	:	node_o09434163, node_father and node_begetter.

These nodes are connected as in **Figure 4** (overleaf) and the following FLogic statements:

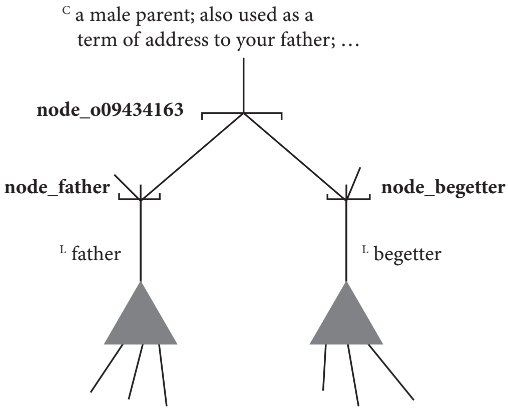

Figure 4 . *RNN with lexical data import from WordNet—'father'.*

```
//FLogic statement of Figure 4
node_09434163 [ to@(1, "a male parent…") ->> node_father ;
       to@(1, "a male parent…") ->> node_begetter ].
node_father[to@(1,"father")->>node_o09434163].
node_begetter[to@(1,"begetter")->>node_o09434163].
```

We can declare more axioms to further conceptualize the building of nections, i.e. the connections between nodes, and at the same time import more data. The following axiom is applied for the importation of hypernym relations from WordNet:

(5)
```
FORALL A,B,P,Q,Ga,Gb,Sa,Sb A:node[to@(1,Hyper)->>B] <-
       Sa[gloss->Ga; hyper->>Sb] AND Sb[gloss->Gb]
       AND A:node[to@(1,Ga)->>P] AND B:node[to@(1,Gb)->>Q].
```

Axiom (5) infers new connections by the **to@** relation with a new identifier, **Hyper.** Hyper labels the hypernym relations in WordNet: **Figure 5** shows the RNN conceptualization according to the WordNet instances in the following FLogic network:

```
//synset instances and hypernym relation from WordNet database
109663987:synsetId[haslemma->"mother"].
109152823:synsetId[haslemma->"adopter"].
109434163:synsetId[haslemma->"father"].
109960590:synsetId[haslemma->"stepparent"].
109725018:synsetId[haslemma->"parent"].
109663987[hyper->>109725018].    109434163[hyper->>109725018].
109152823[hyper->>109725018].    109960590[hyper->>109725018].
```

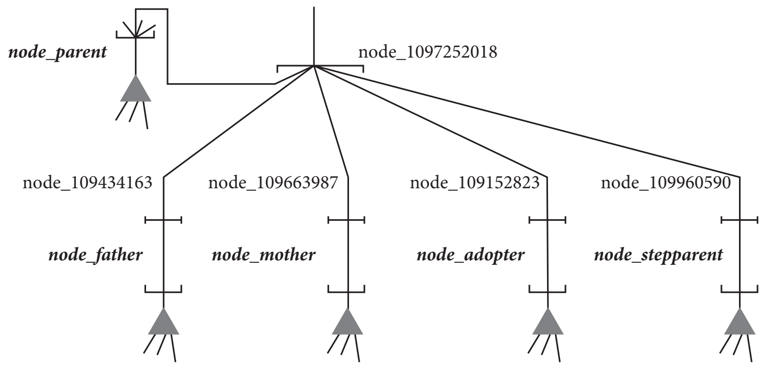

Figure 5 . *RNN with lexical data import from WordNet – hypernym of* parent.

```
//FLogic statements for Figure 5
node_109434163[to@(1,Hyper)->>node_109725018].
node_109663987[to@(1,Hyper)->>node_109725018].
node_109152823[to@(1,Hyper)->>node_109725018].
node_109960590[to@(1,Hyper)->>node_109725018].
```

6. CONCLUSION. Lexemes and sememes do not exist as objects in the human brain. What exist in human brain are millions of interconnected neurons, represented here as interconnected nodes in a Relational Network. 'The cognitive system does not have nor does it need places to store symbols like those of analytical linguistics… Since its information is in the connectivity of the network it requires no storage space other than the network itself' (Lamb 1999:120).

Lexemes and sememes are identifying parameters rather than objects; they are comprehended when corresponding nodes and pathways are activated. At the same time, these parameters govern the connections, act as a function in the ***to@*** method in the computation of node activation in the RNN knowledge base. An activation starts up the connection, triggering both the parameters and the nodes. The totality of activated parameters in sum accounts for the realization of information.

The declaration of axioms creates the connection of nodes which represents the building of nections in Relational Network Theory. The inference power of axioms simulates the increase of connection strength in the generation of established connections from latent connections.

RNN offers a logical schema for the representation of a complex lexicographical database which allows the modeling of various types of linguistic information. With Lamb's Relational Network as a support to the schema of the model, a computerized ontology of phonemic, lexemic, and sememic information is created. To understand and investigate topics in neurocognitive linguistics, it should be useful to have a linguistic information model with lexicographical information imported. Upon the development of knowledge

base modeling, reuse, importation, and mapping of ontology, it will be a powerful tool for information organization.

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A COGNITIVE APPROACH TO SOCIAL NETWORKS

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GROWING EVIDENCE FROM COGNITIVE SCIENCE[1] suggests that knowledge is represented via a network in cognition (Hudson 2001:1). This has led to a re-analysis of the modular view of language in the mind (Chomsky 1986). Consequently, many cognitive linguists now propose that linguistic knowledge is organised in the mind in the same way as other, more general aspects of cognition (see e.g. Langacker 1987; Goldberg 1995:5). This proposal has enormous consequences for linguistics because it blurs many of the distinctions that were traditionally made in linguistic theory. For example, it implies that cognitive linguistic theories no longer recognise a clear dichotomy between linguistic and non-linguistic concepts. Social, cultural and linguistic knowledge are thought to be unavoidably entwined in cognition (Langacker 1994:31–33). Therefore, theories that come under the cognitive linguistics umbrella[2] claim not to deny the importance of the social aspects of language use; they claim not to treat social influences on language as secondary or less important.

However, cognitive linguists have given little consideration to the ways in which a network model of cognition can incorporate the enormous amounts of research that have been generated in the field of sociolinguistics. Furthermore, sociolinguists have paid little attention to the rapidly expanding theories of cognitive linguistics, despite often facing criticisms that sociolinguistics is a mainly empirical subject that lacks any central theory (e.g. see Spolsky 1997:7–8 and Chomsky 1979:57).

This paper will begin to bridge this gap by highlighting one apparent area of crossover between the disciplines of cognitive linguistics and sociolinguistics: their respective treatment of networks. By exploring the links between a cognitive network model and a social network model, this paper demonstrates that there are, in fact, some remarkable similarities between both frameworks. Moreover, the proposed explanation for these similarities is that social networks may, in fact, exist in the mind of the individual. If this is the case, then social networks must exist as part of the larger cognitive network.

The paper is organised in four parts. Section one exemplifies how variation in sociophonetic data can be represented in a cognitive network model. Section two examines the social network structure of the group of speakers from which the data were obtained and highlights the parallels that exist between the social network model and the cognitive network model. Section three explores the possibility that social networks exist in the mind of the individual and section four is a discussion of the implications of this approach.

1. T-GLOTTALING: DATA AND METHODS. The data that follow were collected over a twelve-month period using the ethnographic method of long-term participant observation (Eckert 2000).[3] The sixteen adolescent subjects in this study form a community of

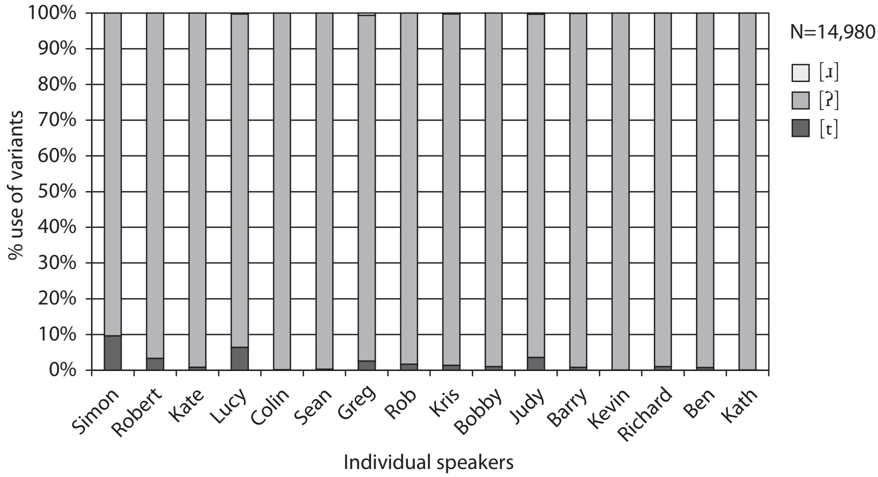

Figure 1. *Percentage use of the variants of (t).*

practice (Eckert & McConnell-Ginet 1992); they play together in a juvenile pipe band in Fife, Scotland. The subjects range between twelve and eighteen years old and, with the exception of one informant (Kath), who is middle class; the socioeconomic backgrounds of the speakers are roughly upper-working class.[4]

The present discussion concerns the patterning of the (t) variable in the group.[5] T-glottaling, the realization of /t/ with a glottal stop (Wells 1982:261), is now a well-established feature of Modern Scots (Stuart-Smith 2003:125). The actuation of this change is unknown, although its presence was noted in the west of Scotland as early as 1860 (Bell 1860:137). T-glottaling is often considered a stereotype of Glasgow speech (Stuart-Smith 2003:125). However, there is evidence to suggest that it has also been a characteristic feature of the Fife dialect since the early twentieth century: 'The glottal catch in place of t between two vowels e.g. in butter, water, is rarely heard in Lothian but is common in Fife' (Wilson 1926:17; cited in Jones 1997:329). The present analysis of t-glottaling is based on auditory transcriptions[6] of six hours of conversation. Following Moore (2003:43), the speakers were recorded conversing with the researcher (myself) in small, self-selected groups of friends. Although this is a relatively small corpus in terms of recording time, the actual number of instances of the (t) variable is substantial. 14,980 tokens were collected in total from the group, an average of 936 tokens per speaker.

Figure 1 is a summary of each informant's percentage use of the variants of (t). The three phonetic variants of (t) in the data are:

1. a released stop [t]
2. a glottal stop [ʔ]
3. a central approximant[7] [ɹ].

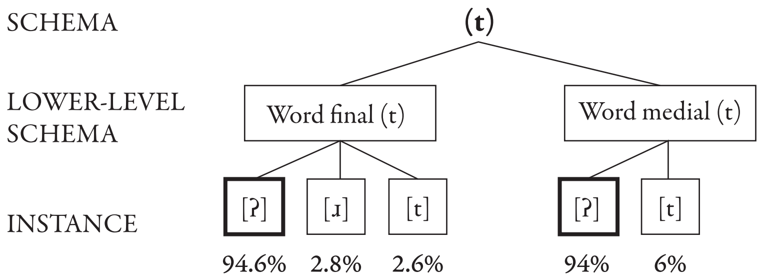

Figure 2. *Schematic representation of the variation in (t) for Greg.*

The striking pattern in **Figure 1** is the minimal amount of variability. All speakers are using between 90–100% of the glottal variant. In order to explain the variation that does exist in the data, however, it is necessary to examine the patterning of this variable for a single individual in the group. As Schilling-Estes (2002:376) explains, 'we cannot hope to achieve a full understanding of the patterning of variation in language… if we do not understand its patterning within individuals' speech'.

1.2. NETWORKS IN COGNITION. The cognitive network model I adopt to explain aspects of this variation is Langacker's Cognitive Grammar (hereafter CG, Langacker 1987, 1991), although the arguments I make are not specific to CG and are applicable to other cognitive linguistic theories.

In CG, the variation in (t) can be represented in the mind of the individual as a series of categorisation relationships between a schema and its instances. This is diagrammed in **Figure 2**.

Figure 2 displays the values of linguistic variation from Greg's recording as a schematic network. 'Schema' is the CG term given to a more abstract representation in cognition which is specified in greater detail by an 'instance' (Langacker 1987:68). Schemas emerge in cognition through abstractions over instances (Langacker 1987:69). Speakers create schemas by abstracting over expressions and recognising some commonality between different instances; different instances then elaborate the schema in different ways.

Trousdale (2002:272) examines t-glottaling in eight possible phonetic environments (four word medial environments and four word final environments, which differ, depending on the quality of the following segment in the sequence). However, this speaker did not appear to be influenced, in his selection of variants, by the quality of the following segment, which suggests that he has not abstracted a level of commonality (or a schema) that relates specifically to the immediate phonetic environment of the instance. He did differ slightly in his selection of variants depending on the position of the segment in the word.[8] Therefore, the data in this study have been divided into only two environments (word medial (t) and word final (t)), which are represented in the network as lower-level schemas, i.e. more fleshed-out characterisations of the higher-level, more general (t) schema.

In each utterance, the speaker has a *choice* between three different variants in the schema. One factor that influences this choice is the degree of **entrenchment** of the variant in the

speaker's cognitive network. In CG, the nodes of a network are described as having various degrees of entrenchment (Langacker 1987:59). The occurrence of any type of mental activity will leave behind a neurological trace. If this event (or, more accurately, event type) recurs, it becomes more and more entrenched in the mind of the speaker through repetition. Event types achieve **unit status** in CG when **automization** occurs and the speaker can activate the structure largely automatically (Langacker 1987:60). The more a particular node is successfully activated, the more entrenched the node becomes, which in turn leads to a greater probability that the node will be selected in another usage event. If we equate entrenchment in CG with frequency of successful use, we can therefore assume that the glottal articulation is very heavily entrenched in Greg's cognitive network (marked in **Figure 2** with a heavy box).

Although this speaker uses the glottal variant around 95% of the time, it seems that some words have a greater likelihood of being realised with a particular variant than others. For example, in the word final schema, *that* (which accounts for 71 tokens) and *it* (which accounts for 70 tokens) are only ever realised with the glottal variant in this usage event. Typically these words appear in a reduced-stress environment, which could perhaps explain why the glottal articulation is more likely,[9] but so too do words like *got*, *get* and *pit* which vary for this speaker. With a closer examination of the variation in these particular words a pattern emerges. It seems that word final [t] is more likely to be selected in a monosyllabic word where the following word is *it*, e.g. *get it* or *pit it*. The consonant at the end of the first word in these examples is often realised as an alveolar stop but the consonant at the end of the second word is realised as a glottal stop. Taylor (2002:258) suggests that certain high frequency word combinations or constructions can become so entrenched that they are stored in cognition and retrieved as whole units. In other words, these high frequency combinations can be accessed directly, rather than via the activation of a schema. It is therefore possible that this speaker has stored these constructions in the same way, with the alveolar articulation first in the sequence.

It is also possible that this speaker has extracted another lower-level schema to encompass instances that occur in the context [monosyllabic word [t] ## [Iʔ]], creating a situation of **schema competition**, which arises when two or more incompatible schemas are candidates for the categorisation of an instance (Taylor 2002:301). The conditions for glottal selection in the (t) schema are massively underspecified because there are very few phonetic restrictions on where it can occur (see note 7). This means that the **elaborative distance** (i.e. the degree to which the schema is underspecified in relation to the instance) between the schema and the instance is great. However, if a schema has been extracted to encompass all instances of the [t] variant word-finally before *it*, the elaborative distance between this lower-level schema and the instance is much less, because this is a very specific phonetic environment. In the case of schema competition, 'the schema with the shortest elaborative distance wins out' (Taylor 2002:302), and so the lower-level schema associated with [t] selection is capable of overriding the very strong entrenchment associated with the glottal articulation in the higher level schema. This pattern of word final [t] before *it* is not confined to the speech of this individual; it was noticed in the data for other individuals in the group and has been commented on in other studies of t-glottaling, e.g. Stuart-Smith

(1999:194), Macaulay (1991:35–36) and Trudgill (1999:132), adding further weight to the proposal that speakers recognise some commonality between these instances and hence may form lower-level schemas to deal with the perceived similarity.

However, although entrenchment in the schematic network is a useful tool in understanding linguistic variation, it does not account for the social meaning that speakers associate with these variants. The majority of instances of [t] for this speaker were motivated by a clear shift in style. For example, throughout this recording, Greg and his taping partner Rob had several mock fights and after each one, they proceeded to recite the details of the fight to the tape in a **news reader** or **commentator** style, usually beginning 'for the benefit of the tape...' (see example 1).

(1) G: by the way ma knuckles actually sair
R: [laughing] so's ma fucking heid. [commentator style] For the benefi**<u>t</u>** of the tape, Greg has once again
G: [commentator style] assaul**<u>t</u>**ed Rob
R: yes
G: [commentator style] in an vicious and... provoked manner
R: provoked?
G: [commentator style] yes. You, like, make comments abou**<u>t</u>** my mother...

It is clear from example 1 that, for these speakers, commentator style is characterised, not only by the use of (t): [t] but by the selection of a more standard register generally, e.g. note the use of *yes* rather than Scots *aye*; *mother* rather than Scots *maw* [mɔː] or *mer* [mɜːɹ]. Israel and Kemmer (1994:174) argue that 'particular forms or whole classes of forms may become stereotypically associated with the sorts of speech act situations in which they are most commonly experienced'. It therefore seems reasonable to suggest that, through the repeated co-activation of particular linguistic nodes in particular social contexts, these speakers have come to associate the glottal articulation with a default or informal style of speech, and the alveolar articulation with a style typical of commentators. Therefore, although the glottal articulation is very heavily entrenched in the speaker's cognitive network, entrenchment is not the only factor influencing the choice of this particular variant. When this speaker switches to another speech style that he associates with the [t] articulation in his cognitive network, he is capable of overriding the heavy entrenchment of the glottal stop and selecting the [t] variant.

Thus phonological variation in linguistic data can at least be modelled in a cognitive network and both social factors (e.g. style shifting) and linguistic factors (e.g. schema extraction and entrenchment) influencing the variation can be accommodated in the same theoretical framework.

2. SOCIAL NETWORKS. A substantial body of research has been carried out in recent years on the assumption that networks also exist in society. Milroy (2002:549) defines social networks as 'the aggregate of relationships contracted with others'. Social Networks are often described in terms of **density** and **multiplexity**, where density relates to the number

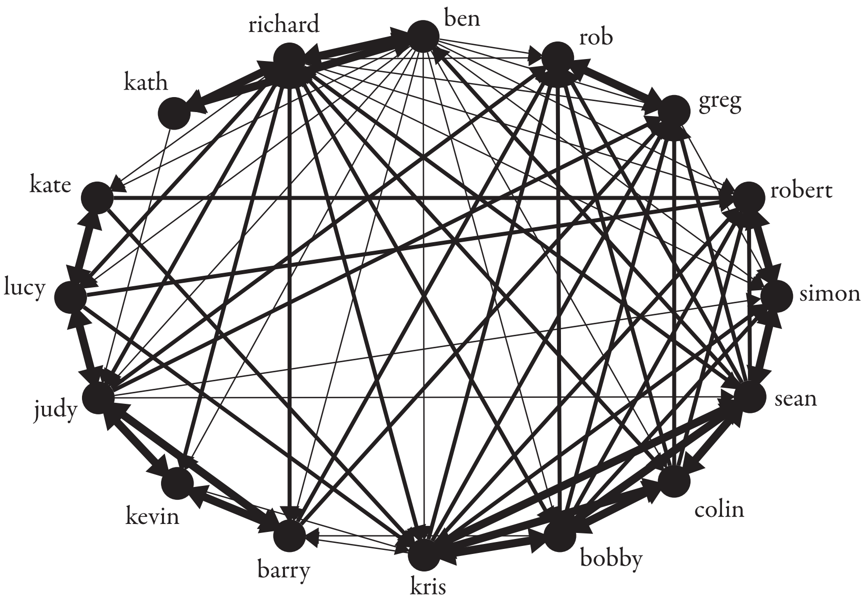

Figure 3. *Social Relationships in the West Fife High School Pipe Band*

of ties (or links) between individuals in a network and plexity relates to the nature of these ties. A maximally dense, multiplex network is therefore one in which all members of the network know each other and they all know each other in more than one capacity.

However, a typical social network analysis does not simply describe the links between individuals in a group in terms of density and multiplexity, it also attempts to quantify these relationships in some way. Milroy (1980:141–42) measured the network strength of individuals by placing them on a six-point scale according to five factors relating to their position in the immediate neighbourhood. This method of quantification was inappropriate for the adolescents in this sample because they do not form a territorially based cluster in the neighbourhood in the way that Milroy's subjects did. Following Cheshire (1982), I therefore based the social network analysis of this group solely on measurements of friendship links. **Figure 3** is a sociogram displaying the positive and negative relationships that the informants felt existed among them. Negative links (or dislike links) are represented with thin lines, positive links (or friendship links) are represented with thicker lines and reciprocal friendship links are represented with very thick lines. The network analysis was performed by UCINET 6.79 and diagrammed using NETDRAW (Borgatti, Everett & Freeman 1999).

By comparing the social network model of **Figure 3** with the description of the cognitive network model presented in section 1, we can see that there are some clear parallels between the two models. The relationships between nodes of the cognitive network and speakers in the social network model are described in terms of a series of ties or links. The ties in the social network can vary in entrenchment (or multiplexity) as can the links between nodes in

cognition, and the nodes themselves can also vary in entrenchment in the cognitive network model as can the degree of familiarity with any given speaker in the social network.

Of course, simply comparing any two network models, particularly bounded networks such as those described above, is likely to produce similarities. The reason I propose that these networks are similar stems more from some of the problems that have been recognised with the social network approach, particularly with the assumption that social relationships between individuals can be accurately quantified. Milroy's (2002:550) approach to SNA distinguished between **strong** ties (i.e. kin or close friends) and **weak** ties (i.e. ties with acquaintances). Yet it is unclear, for instance, how speakers (or analysts) distinguish a friendship tie from an acquaintance tie. Do all speakers make this distinction at the same level of acquaintance? How does the analyst deal with kin ties that mean little to the speaker or where the interaction is infrequent? It seems that describing social relationships as categorically strong or weak is a huge simplification. Social relationships are not binary; they are gradient, dynamic and often very complex.

The main problem with previous attempts to quantify social ties stems from a failure to recognise the true nature of these ties. Ties in a social network symbolise social relationships, but these relationships only exist because individuals perceive them to exist. If this is the case, then social relationships must only exist in cognition. When analysts assign a value of strength to a social network tie, it therefore has to be acknowledged that they are actually assigning a value to links in a cognitive network, and this is not easily quantifiable.

I therefore suggest that social networks and cognitive networks are not only similar network models; they may, in fact, be exactly the same cognitive structures. If social networks are simply another sub-network of knowledge, then they are ultimately linked to other aspects of knowledge, some of which is more 'linguistic'. But because the theory does not recognise a clear dichotomy between linguistic and non-linguistic concepts, there is no need to separate linguistic and non-linguistic nodes in this model.

This section highlights some of the ways in which data from this group of adolescents can also be modelled in a social network and draws parallels between social and cognitive networks.

3. SOCIAL SPACE. Despite these parallels, clear differences remain between the models. The main difference is that the cognitive network model discussed in section 1 represents an individual speaker's knowledge but the picture of the network that is presented in a social network analysis or a sociogram (as in **Figure 3**) does not correspond with the mental representation of any one individual. If it is indeed the case (as a usage-based model of cognition like CG suggests) that knowledge is based on previous experience, then no two individuals will share exactly the same mental representation of this social network, as no two individuals will have had exactly the same experiences of the network. Therefore the networks that speakers perceive to exist cannot be accurately mapped by sociograms. Social networks are difficult to measure objectively and we do not get a full understanding of what these relationships actually mean to individuals in a given community. Milroy (2002:556) claims that SNA is a 'participant rather than an analyst concept', but this sociogram is an abstraction over all of the viewpoints of individuals in the network. It is

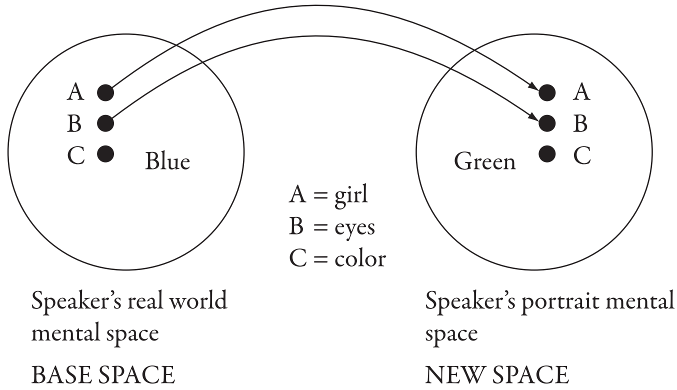

Figure 4. *'In Len's painting, the girl with blue eyes has green eyes'.*

far removed from reality; it can only exist as an analyst's construct. Of course, individuals perceive the existence of social relationships; but such relationships exist in the minds of these individuals, so we need a model of social cognition that focuses on the individual's conception of the network. The model I propose draws on the cognitive theory of Mental Space (Fauconnier 1994 [1985]).

Mental spaces have been defined as 'partial assemblies constructed as we think and talk, for purposes of local understanding and action' (Fauconnier 2005:1). They are high-level cognitive structures that operate in the 'cognitive background' of speech production and processing, typically below the level of conscious awareness (Fauconnier 1994:xvii), and they are invoked and stored in working memory as discourse unfolds. Mental spaces should not be considered as an alternative to the network model. According to Fauconnier (2005:2), they are sets of 'activated neuronal assemblies'. In other words, they are pockets of active nodes in the network connected by various types of 'mapping' (or linking) devices which ultimately shape into large-scale conceptual networks.

Fauconnier and Turner (1998:134) argue that mental space construction is one of the basic cognitive operations of the human mind. But if we are not consciously aware of forming these structures, how can we be sure of their existence? They also argue that mental spaces are not only psychologically plausible, they are necessary in order to explain our human ability to imagine and to construct mental models that do not (indeed cannot) have direct referents in the physical world. They can also explain our ability to understand apparent contradictions.

Perhaps the most often cited example of evidence for the existence of mental spaces comes from Fauconnier (1994:12): 'In Len's painting, *the girl with blue eyes has green eyes*'. In order to understand this example, it is necessary to invoke two mental spaces, one containing the elements of reality (as the speaker perceives it) and another containing the elements of the portrait that is set up by the adverbial space builder *in Len's painting*.

The large circles in **Figure 4** represent mental spaces. Structure from the **parent space** or the **base space** is transferred into the new space by default and so space building typically goes unnoticed. This is known as the **access principle** or the ID principle (Fauconnier 2005:3). In this example, however, there is a mismatch between the structure in the parent space and the new space, highlighting the existence of the mental spaces. The girl in the painting is the same girl as in the speaker's reality, but the colour of her eyes in the reality space is different from their colour in the portrait space.

Fauconnier (1994) further proposes the existence of various **types** of mental space: time space (e.g. in 1929), space space (e.g. in Moldova), domain space (e.g. in Canadian football) and hypothetical space (e.g. if P then Q). If mental space building is a fundamental aspect of cognitive processing that is therefore not specific to language and if social knowledge is as much an aspect of the knowledge of an individual speaker as linguistic knowledge, then surely we must be able to posit the existence of social space, a mental space construction that models the individual's conceptualisation of themselves and their place in society. The concept of social space is certainly psychologically plausible (or at least no less psychologically plausible than any other type of mental space) and the term is, in fact, already used by Hudson (1996:11), who argues that society is structured in cognition as a 'multidimensional space' and that we can choose to locate ourselves along various dimensions within it.

Mental spaces are created by abstracting over experiences in interaction and they are structured around domains.[10] For instance, within the domain of 'boxing', Fauconnier (2005:3) explains that a mental space may be organised by the specific domain (e.g. boxing) or by a more generic domain (e.g. fighting) or by an even more generic domain (e.g. competition). Similarly, the individuals in this study may profile their social network against the very specific domain of the West Fife High School Pipe Band or against the more generic West Fife High School or against an even more generic domain of the piping community (as well as a variety of other social domains that may be relevant for these individuals).

Each individual may recognize different members of the group as more salient in their own conception of the network for different reasons (perhaps because they feel connected by a positive or a negative link). These salient individuals constitute the **figure** of the social space, where the figure in a scene is the CG term for the substructure perceived as standing out from the remainder of the scene, which constitutes the **ground** (Langacker 1987:120). Each individual is aware of the existence of others in the network (because they are aware of who is and who is not a member of this band), but these other individuals may not be particularly prominent in some speakers' mental picture of the group and so they constitute the ground.

It is also owing to some kind of salience that an entity is used as a reference point in CG. Reference point construction is described as 'the ability to invoke the conception of one entity for purposes of establishing mental contact with another' (Langacker 1999:173). Cognitive reference points are salient entities that the individual can use to locate non-salient entities in the world. The individuals which hold some salience in the speaker's cognitive network are therefore likely to function as cognitive reference points, landmarks in cognition that the speaker can invoke relative to which he can locate others and position himself within the multi-dimensions of social space.

The main difference between the social space model and a typical social network analysis is that the social space model recognises that social relationships are mental constructs and are therefore dynamic structures that exist in the mind of the individual. As such, it has the capacity to explain sociolinguistic variation between speakers because it can question how speakers make associations in cognition between social knowledge and linguistic knowledge. In other words, it can allow us to question how speakers give social meaning to linguistic variants at the most local level of analysis possible—the mind of the individual.

4. CONCLUSIONS AND IMPLICATIONS FOR FUTURE RESEARCH. In section 1, I argue that we perceive certain linguistic variants to be linked to other linguistic variants in cognition by categorisation networks. In section 2, I explain that we also perceive the individuals we encounter in society to be linked to ourselves and to other individuals in similar ways. However, in a network model of cognition such as CG, there is no clear dichotomy between linguistic and non-linguistic concepts. There is therefore no need to separate linguistic and non-linguistic nodes in this model. Through the repeated co-activation of particular nodes and links in the network, speakers come to abstract relationships of similarity between certain linguistic variants (such as those of the (t) variable) and certain individuals or types of individuals (e.g. commentators, friends, enemies) in their cognitive network. All of this information then enables the speaker to build up a prototype and extract a schema of a particular social type that includes both linguistic and social knowledge.

The main argument proposed in this paper is therefore that social networks and cognitive networks are not just similar network models; they may, in fact, be exactly the same cognitive structures. If this is the case then social networks are simply another sub-network of knowledge that are ultimately linked to other aspects of knowledge, some of which happens to be more directly 'linguistic' in nature. Furthermore, the concept of social space is both psychologically plausible and theoretically important, because it offers linguistic theory a way of modelling social structures that are relevant to individual speakers and not the abstract sociograms that are proposed by social network analysis.

Given the psychological evidence for the existence of network structures in the human mind, this conclusion may seem unsurprising, yet it is a conclusion that is very rarely drawn. As Hudson (1986) explains, little interaction exists between the disciplines of cognitive linguistics and sociolinguistics, despite the obvious common ground they share. The majority of those working in cognitive linguistics (and related disciplines such as neuro-linguistics) still fail to articulate the importance of the social aspects of language use. Despite invoking models that are designed to incorporate social knowledge and sociolinguistic variation, cognitive linguistics continues to retain a traditional focus on language structure at the expense of language use (Geeraerts 1995:115).

The work presented here shows that it is not only possible but beneficial to incorporate both social and linguistic information within the same theoretical framework and that there is a need to recognise the importance of such a synthesis. Of course, there remains a series of questions regarding the precise nature of the network I have proposed. For instance, what exactly is the nature of the phonological nodes and on what basis do speakers perceive similarity between instances? The key to answering these questions, it seems, lies in the

combination of sociolinguistic and psychological methods of data collection and cognitive linguistic methods of analysis.

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[1] Much of what appears here is based on a chapter of my MSc dissertation (Clark 2005) and I am grateful to Graeme Trousdale, Anne King, Jane Stuart-Smith and Dick Hudson for their comments on this work. I would also like to acknowledge the helpful comments of the Language in Context Research Group at Edinburgh (and in particular, Miriam Meyerhoff) and the audience at the NDCL conference in Brighton (October 2005) where parts of this idea were also presented. Acknowledgement is also due to the anonymous reviewers whose comments were extremely useful.

[2] Cognitive Linguistics is the general cover term given to a range of theoretical approaches in modern linguistics such as Word Grammar (Hudson 1984, 1990), Construction Grammar (Goldberg, 1995) and Stratificational Grammar (Lamb 1999). These approaches differ at the level of specific detail but they all take a fundamentally non-modular view of language.

[3] These data form part of the corpus collected for Clark (2005). This was a pilot study that was conducted for an MSc dissertation with the intention of expanding the research into a larger PhD project.

[4] This assumption is based entirely on qualitative observations of parents' occupations (e.g. police officer, fork-lift driver, contractor, technician, plumber etc.), the schools the adolescents attended (Kath is the only member of the group to attend a fee-paying school); and the socio-economic characteristics of the area—this particular area of West Fife, where most of the adolescents live, was the least expensive place to buy property in Britain in 2003 (*http://www.hbosplc.com/economy/includes/01-01-04-scottishwinnersandlosers.doc*). No attempt was made to assign these speakers to a social class index.

[5] It is generally accepted as practice in sociolinguistics to enclose sociolinguistic variables (i.e. collections of variants that pattern in accordance with particular social and linguistic factors) in rounded brackets and variants of these variables in square brackets.

[6] This measurement of phonological variation was felt to be sufficient for the purposes of this pilot study because the variants of this variable are, at least auditorially, discrete consonantal alternations.

[7] This latter variant (discussed by Carr (1991) in Tyneside as T→R weakening) occurred sporadically and very infrequently.

[8] This explanation is slightly oversimplified because it does not consider syllable structure. The medial stop in e.g. *butter* is much more likely to be glottalised than the medial stop in e.g. *tattoo* because the stop in *tattoo* is foot initial and, as Trousdale (2002:273) explains, textbook accounts of glottaling in English (which are based primarily on RP) suggest that t-glottaling is not possible word- or foot initially. However, (as in Trousdale 2002:273 and Docherty *et al.* 1997:290) there are instances in these data that do not confirm this generalisation. For example, with the exception of Kath, all speakers display variation between the glottal and the alveolar realisations word initially in the lexical item *tae* (the Scots form of 'to') and also word medially in, for example, *fourteen*.

[9] Docherty *et al.* (1997:300) note the apparent stylistic function for some speakers to use the 'fully released variant to mark emphatic stress'.

[10] Fauconnier uses the term frames, introduced by Fillmore (1982), which is similar to the notion of domains in CG. I use the term domains to avoid confusion in the terminology.

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SYNTACTIC AND SEMANTIC PATTERNS OF PEDANTIC SPEECH IN ASPERGER'S SYNDROME

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INDIVIDUALS WHO HAVE AUTISM SPECTRUM DISORDERS (ASD) comprehend expressions semantically but often have trouble resolving ambiguity when the context is not constrained (Happé 1997). They are comfortable with literal interpretations of discourse but can have overly literal interpretations and may not understand jokes or metaphors (Happé 1998). The spoken discourse of people with ASD can be quite technical and often reflects register-specific varieties, but individuals with ASD do not move flexibly between registers and often use linguistic expressions in the wrong contexts (de Villiers & Szatmari 2004). Such difficulties in social communication seriously impede everyday social functioning of people with ASD throughout their lifetime, but the precise nature of communication problems in this disorder is not fully understood, particularly in relation to cognitive functioning. A better understanding of the nature of semantic patterns in ASD speech is needed in order to develop targeted interventions.

There is some evidence in imaging research that suggests there is reduced right hemisphere function in autism. Right hemisphere function is responsible for maintenance of multiple connections and is directly involved in contextually based language use, including the comprehension of language features that require listeners to evaluate multiple meanings and discern intended meaning (e.g. humor, irony). There is also evidence of reduced synchronization of activation among brain areas.

This present study reviews the literature that suggests at least preliminary support for right hemisphere involvement and problems in connectivity between brain areas in ASD. The literature review is used as background for a text analysis of pedantic speech in a sample of Asperger's Syndrome discourse. Semantic patterns are characterized and considered in terms of the research on brain bases reviewed now.

1. BACKGROUND. ASD is a continuum of disorders that includes autism, high-functioning autism (HFA) and Asperger's Syndrome (AS) and is characterized by qualitative impairments in social reciprocity, including linguistic social impairments. Most of the communication impairments in ASD are pragmatic difficulties. These difficulties are mostly interpreted within the Theory of Mind (ToM) framework, the theory that people with ASD do not recognize mental states of others.

2. NEURAL BASIS. There is a growing literature on brain basis and the links between cognitive and biological studies in autism (U. Frith 1997). Current findings indicate no clear evidence for structural abnormalities in ASD. The most robust finding to date is the greater

brain weight in autism. This differential is not present at birth but is estimated to be between 100–200 grams or 5–10% more than expected in people under 12 years of age (C. Frith 2003, Bauman & Kemper 1985). Areas of the brain that studies have commonly found to be involved in autism include the limbic system (Bishop 1993), especially the amygdala (Shultz & Klin 2002) and the frontal lobes (Stuss & Anderson 2004, Minshew *et al.* 1997; Russell 1997). One major theory of the underlying cause of autism is Executive Dysfunction (EF), or frontal lobe dysfunction (Russell 1997, Minschew *et al.* 1997). Specificity of findings for brain regions has not been consistent. Recent studies have looked at Right Hemisphere (RH) involvement, Theory of Mind (ToM) reasoning, white matter and connectivity. Each of these four areas is discussed in turn.

2.1. RIGHT HEMISPHERE INVOLVEMENT. The recognition of the significant contribution of the RH to language, combined with the profile similarities between RH damage and ASD, has led to greater activity investigating RH dysfunction in ASD, while recognizing that function in both hemispheres needs to be intact for pragmatic communication to succeed. Several studies have described a profile seen in people with RH dysfunction that is similar to that found in AS (Ross & Mesulam 1979, Gunter *et al.* 2002) and some suggest a link between AS and right-sided cortical dysfunction (Ellis & Gunter 1999). Similarities to RH dysfunction invite comparison and, some argue, provide preliminary support for RH involvement (Joliffe & Baron-Cohen 2000).

Features that have been found to be associated with the right hemisphere include difficulties with:

(a) socially appropriate use of language (Ozonoff & Miller 1996);
(b) discourse comprehension and production (Gardner *et al.* 1983, Hirst *et al.* 1984, Code 1987, Bryan 1988, Obler & Gjerlow 1999);
(c) conversation management, including topic and turns (Winner & Gardner 1977, Wapner *et al.* 1981, Brownell *et al.* 1983);
(d) expectations about the organization of conversational and written texts, including quantity, choice and maintenance of appropriate level of formality, depending on context (Obler & Gjerlow 1999);
(e) generating inferences (Myers 1999, Coney & Evans 2000);
(f) non-literal language such as metaphor and humor (Gardner *et al.* 1983, Ozonoff & Miller 1996, Bottini *et al.* 1994, Monetta *et al.* 2004, Joanette 1990, Rogers *et al.* 1996; Myers 1999);
(g) interpreting words or phrases with more than one meaning (Shields *et al.* 1996);
(h) comprehension of speech acts (Hirst *et al.* 1984); and
(i) emotional prosodic processing (Ross & Mesulam 1979, Ozonoff & Miller 1996).

Each of these areas of difficulty is also described in the literature of autism discourse and pragmatics.

2.2. THEORY OF MIND REASONING. One recent direction implicating right lateralization involves attempts to characterize neural correlates of ToM. Sabbagh (2004) looks at Event Related Potential (ERP) activity to examine orbitofrontal contributions to ToM reasoning. He finds that decoding others' mental states is associated with the anterior frontal systems (most likely related to the orbitofrontal/medial temporal circuit), and that these may be lateralized to the right hemisphere. (This is contrasted with reasoning about mental states, where reviews of considerable evidence suggest that the left hemisphere makes critical contributions cf. U. Frith & C. Frith 2001.)

2.3. WHITE MATTER ABNORMALITIES. Gunter *et al.* (2002) suggest that the neurological underpinnings of AS may be dysfunction of white matter affecting right hemisphere functioning and interhemispheric communication. (White matter consists of the cables that connect the various parts of the brain to each other and facilitate communication between and within hemispheres.) Some speculative research (Rourke 1987, 1988) suggests that the right hemisphere is more susceptible than the left because of its greater abundance of white matter and relatively longer communication links.

2.4. COOPERATION AND CONNECTIVITY BETWEEN BRAIN REGIONS. In participants with autism, Just *et al.* (2004) find systematic differences in the distribution of brain activation across main language areas (Wernicke's and Broca's) using functional magnetic resonance imaging (fMRI) techniques. Participants with high-functioning autism produced reliably more activation than the control group in the regions associated with the processing of meaning of individual words (the left superior temporal gyrus/Wernicke's area) and less activation in regions associated with the processing of syntactic meaning (the left inferior frontal gyrus/Broca's areas). Just *et al.* hypothesize that participants with autism may rely more on an enhanced word processing ability (signaled by more than normal activation in Wernicke's area), and less on integrating processes that bring the words of a sentence together into an integrated syntactic and semantic structure (signaled by less than normal activation in Broca's area).

In the same study, they also find differences in functional connectivity. The functional connectivity between the various participating cortical areas was consistently lower for the participants with autism than for the control participants, suggesting the brain in HFA engages less in the integrative aspects of sentence processing than the brains of control participants, hence the Theory of Underconnectivity.

Overall, the results described converge on a picture where, on the whole, the right hemisphere is involved in the integration of information and world knowledge as well as the organization of information at the pragmatic communicative level, and this function is limited in people who have ASD. The reduced connectivity in ASD limits coordination and integration between different brain areas.

3. SEMANTIC PATTERNS: PEDANTIC SPEAKING. I now present two excerpts of spoken discourse to illustrate one kind of linguistic behavior characteristic of ASD—pedantic speaking. In pedantic speaking a speaker uses a register-specific variety that sounds like the

original context in which it was used, often with more technical detail and specificity than the context demands (Gunter *et al.* 2002, Attwood 1997). The discourse sample is from a follow-up study of children who were assessed or in treatment at a Pervasive Developmental Disorder service of six different centres that serve preschool children with developmental disabilities in southern Ontario. In this study, spoken conversations with children and adolescents diagnosed with ASD were audio-taped and transcribed. The text analyzed is a semi-structured conversation involving a young man with AS who has been characterized as pedantic. This conversation has three major phases:[1] a casual conversation portion and two pedantic stretches, one on a favorite topic.

Example (1) is a portion of the *pedantic* phase on the favorite topic, weather:[2]

(1) CHI: um -: what month was this?
RES: that was in # July.
CHI: that might have been the uh time of the severe thunderstorm outbreak.
RES: I think so.
CHI: with the # six tornadoes.
RES: mmhm.
RES: I think it was.
CHI: (be)cause they were saying that was the worst severe thunderstorm outbreak to ever occur in cottage country.
RES: uhhuh?
RES: <I think there> [>].
CHI: <there were> [<] six tornadoes.
RES: mmhm?
RES: I think there was just too much hot weather at once eh?
CHI: yeah.
RES: and that caused it.
CHI: yeah.
CHI: when you get temperatures of ninety-five the # the air sometimes rises itself.
CHI: and then # causes a storm without a cold front.
RES: mmhm?
CHI: so you can get severe storms either from # hot air rising up so high that it cools off or # a hot air mass actually colliding with a different cold air mass.
RES: mmhm?
CHI: and I'm sure it must o(f) been a cold front if the storms were that bad # with tornadoes.

The speech of the speaker with AS has characteristics associated with written (or expert) text. Syntactically it is complex. There is also considerable register-specific lexis associated more with weather reporting than casual conversation. The pattern differs, however, in the more casual phase, which occurs at the beginning of the conversation.

Example (2) is an excerpt from the *casual* phase:

	W	LW	S	C	IC	MLU	CC	LD
Phase 1	125	42	18	27	25	5	1.08	1.68
Phase 2	106	63	8	13	11	10.47	1.18	5.73
Phase 3	1000	442	92	182	100	10	1.82	4.42
Overall	1231	547	118 (10.4 wps)	222	136	9.05	1.63	4.02

Table 1. *Syntactic Complexity and Lexical Density. Key:*

LW = lexical words
S = sentence(s)
IC = independent clauses
MLU = mean length of utterance (number of words per independent clause)
CC = clause complexity
LD = lexical density
wps: words per sentence
Phase 1: casual conversation
Phase 2: pedantic – recipe
Phase 3: pedantic – favorite topic (weather)

(2) RES: you said that after uh dinner you were going to do some.
CHI: grocery shopping.
RES: grocery shopping.
CHI: yeah.
RES: mmhm.
CHI: that's not fun.
CHI: but it has to be done.

Comparison of syntactic complexity in the text's three phases included measures of Mean Length of Utterance (MLU, measured by the number of words per independent clause) and clause complexity (measured by the ratio of dependent clauses [all types] to independent clauses). Comparison of lexical density was measured by the proportion of lexical words to total words. Results are presented in **Table 1**. For each of the three phases lexical density and syntactic complexity are compared. Semantic patterns are then discussed and the applicability of neural findings to pedantic speaking in ASD is considered.

Both lexical density and syntactic complexity are greater in written than spoken text, since lexically dense or syntactically complex clauses require more information processing. In this text, the young man's scores were consistent with norms for written text (10) for syntactic complexity in the pedantic phase and consistent with spoken norms (5) for the more casual phase: his scores were (5) for the casual portion and (10) and (10.47) for pedantic portions. The overall MLU for the conversation was (9.05).

For lexical density as well, it is apparent that the casual portion is much less lexically dense than the pedantic portions. One observation that can be made is that in this text over all, the pedantic stretches represented most of speaker's discourse. Had the pedantic

phases represented a smaller proportion of the text, the overall MLU score would have been significantly affected. This highlights the value of a representative data sample but also the value of a close text analysis that shows the variation in semantic patterns, here realized as different phases (casual and pedantic).

The speaker's text is also quite verbose, partly as a consequence of the lexical density. To further characterize this quality, lexical repetition and collocation patterns are now examined.

3.1. REPETITION OF WEATHER ITEMS. Of the five most common lexical items, four are weather words and one (*severe*) regularly collocates in a marked way. The five most common lexical items follow, with number of occurrences appearing in parentheses: *thunder* (18), *lightning* (13), *tornado* (7), *severe* (7) and *clouds* (6). Other weather words occur as well, making this a very rich lexical set:

(3) *thunder, lightning, tornado, clouds, wind, storm, power, hot, high, fall, rain, strikes, cold, mass, front, downpour, conditions, temperatures, hurricane, threaten, brew, rise, cool, bolts, knocking, flashing, cracks, growing, gusts, loud, sounds, gear, activity, humid, forecasting, breaks, calm, streaks, bang, continuous, line, strokes, chain, ground*

3.2. WEATHER COLLOCATIONS. The other very marked pattern in this text is one of register-specific collocations from the field of weather reporting (e.g. 'we're getting back into fall temperatures'; 'today it threatened to thunderstorm'; and 'and if conditions are right that could trigger off a thunder storm later'). There is significant technical vocabulary and detail, with attention focusing on the register rather than the salient points.

4. DISCUSSION: APPLICABILITY OF NEURAL FINDINGS. Individuals with ASD have difficulty with many of the linguistic functions that seem to be supported by the right hemisphere, such as disambiguation or understanding of metaphor, instances of language that require the listener to evaluate and maintain multiple meanings and discern which meaning best reflects a speaker's communicative intent. This may relate to neural connectivity because the patterns exhibited in ASD seem to reflect a simple kind of modeling where fewer connections are made between multiple models.

In the case of pedantic speaking, the speaker talks about a particular topic without being able to link up the discourse with semantic patterns that are new. It would appear that the generic situation-specific variety is internalized and used each time the topic is addressed, without recontextualization from the context in which it was first learned. Looked at this way, pedantic speaking can be seen as another case where there are problems in multiple modeling or multiple inheritance. Thus the rigid use of specialized register-specific lexis seems to reflect a special interest but also allows speculation about neural connectivity.

Just *et al.* (2004) propose a link to the theory of Weak Central Coherence (U. Frith 1989), the theory that people with autism have a local processing style with localized skills and special interests. They propose that the brain likely adapts to low connectivity by developing more independent, free-standing abilities in each brain centre. Activation

patterns may be different when a person is speaking on a favorite topic. While the pedantic phase is more verbose, it is also syntactically more complex, suggesting that the material may be over-coded and recalled, with the syntactic structures coming straight out of the register. It is interesting to speculate that speaking about favorite topics may afford some communicative advantages, such as posing less demand on processing relative to the demands of more open-ended causal conversation.

5. IMPLICATIONS FOR FUTURE RESEARCH. Current research into semantic patterns in ASD may be useful in the assessment of communication skills in ASD and for the planning of individual treatment programs. Observable patterns could be used to develop validated measurement tools for assessing the presence and extent of impairments in individual speakers. Specific patterns could also be targeted for interventions. In the future, semantic patterning could also be related to underlying mechanisms for a better understanding of the causes of communication difficulties in ASD.

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[1] *Phases* are stretches of discourse that reflect micro-registerial shifts in discourse. See Gregory 1988, Stillar 1991 and Asp 1992.

[2] Symbols follow CHAT conventions for the CHILDES language data exchange system:

RES	=	research technician
CHI	=	child
[>]	=	overlaps with following text
[<]	=	overlaps with preceding text
#	=	pause
-:	=	syllable lengthened

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THE LOSS OF FRENCH IN ANTEBELLUM LOUISIANA: A SOCIAL NETWORK PERSPECTIVE

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This study uses the notion of social network to examine and, to some extent, explain the transition from French to English as the language of public life in Northern Louisiana by the time of the Civil War. It is based on the language practices of one white French creole family that can be inferred from the writings preserved in the *Prudhomme Family Papers* (#613), held in the Southern Historical Collection at the University of North Carolina at Chapel Hill.

Fundamental to a social network approach to language analysis is the belief that variation in linguistic form and use and also language change are motivated in large part by the fact that language is a social activity. It follows that the language people use can be influenced by their relationships to the other speakers with whom they interact, i.e. their social network. Social network analysis was established as a tool of current sociolinguistics by the work of James and Lesley Milroy in three urban communities in Belfast, Northern Ireland, in the 1970s (L. Milroy 1980, 1987).[1] In his historical account of the development of English, James Milroy (1992) suggested that the generalizations derived from their synchronic studies might apply to earlier stages of English and help account for some notable instances of rapid change. Social network analysis has now become a tool of historical sociolinguistics, too.[2]

Classic Labovian sociolinguistics shows correlations between the forms of language used by speakers and well-established categories that can be said to be characteristics of speakers, such as socio-economic class, sex, age, ethnicity, and educational level. A network approach is useful for examining linguistic variation among speakers who are not differentiated by most of these major social categories, e.g. the speakers in a small rural town who are of the same ethnicity, educational level, and religion yet show systematic differences in speech.

'An individual's social network is quite simply the sum of relationships which he or she has contracted with others, and social network analysis examines the variable structures and properties of personal networks' (L. Milroy 2000:217–18). Networks take as their point of entry an individual speaker. Through language, that speaker has relationships with others. Setting aside the content (or properties) of the network relationships, direct links are called first order; links through another speaker are called second order. An individual speaker can have many, or few, first order and second order links. Density is the measure of the number of relationships among people in the network (i.e. total actual links) divided by the total possible links in the network. For example, in a network of ten people, ninety links are possible. If there are forty-five links, the density is fifty percent. In a maximally dense network, every individual is linked to everyone else, with a density of one hundred

percent. An individual speaker can be central to networks or peripheral. Sets of networks can cluster. First and second order links show the structure of the network.

Adding content to the links makes network analysis a more powerful tool. The term *multiplexity* refers to the number of different ways in which two members of a network are related. Discovering the social features that constitute meaningful multiplex links for a network is a challenge to investigators. Properties that are important may differ from one community to another, and may change. Other characteristics of linkages that contribute to the strength of ties and might elucidate the social dynamics are frequency, duration, and reciprocity—though these have not been as fully elaborated in studies as has multiplexity.

In the populations that the Milroys were studying synchronically, they found that dense, multiplex networks—in which most of the speakers are linked to each other by several measures— tend to be norm-enforcing and to conserve language features (in the instance of their Belfast communities, to conserve vernacular features). Loose ties, on the other hand, provide the route for innovation and change. Mobility and migration often place speakers in situations in which their ties are loose (or weak) and their position is marginal to a cohesive, well-established group. The weak ties of these individuals tend to be the conduits to localized networks of new information, ideas, and linguistic forms (L. Milroy 2000:217–19). 'The challenge for the historical sociolinguist is to show which ties are meaningful to the groups and the individuals who are being studied' (220). This in turn requires a good understanding of the historic context of the documents under study.

At the time of the Louisiana Purchase in 1803, French was the language of the population of European descent in the territory that became the state of Louisiana, even though Louisiana had been a colony of Spain for close to forty years. In the twenty-two southern parishes that now compose 'the Cajun triangle', French was retained as the primary language until World War II. However, northwest of Alexandria, along the Red River, French had disappeared from the public sphere by the time of the Civil War. In the antebellum period, that part of Louisiana was home to French-speaking white creoles[3] and their creole slaves and to a coherent community of free, creole mulattoes. The center of population was Natchitoches, founded in 1714 and the oldest town in the Louisiana Purchase territory. By the time of the Civil War, the creole population was greatly outnumbered across Northern Louisiana by English-speaking Americans who had come there since the territory had become a part of the United States.

What spurred me to undertake a historic study of language contact in this part of Louisiana was the recent availability of a large collection of documents belonging to a single family who had lived in the area around Natchitoches since the earliest days of settlement.[4] The *Prudhomme Family Papers* held by the Manuscripts Department of the Library of the University of North Carolina at Chapel Hill comprise more than 16,000 items dating 1765–1997 and occupying 41 linear feet of shelf space. They include personal correspondence, business correspondence, school composition books, scrap books, greeting cards, invitations, and such financial records as ledger books, promissory notes, acts of sale, and inventories. Several thousand items date from the century preceding the Civil War. Documents in the collection from before the 1830s are overwhelmingly in French. The Prudhomme

family papers offer an opportunity for linguistic study by providing the sociolinguistic backdrop for the change from French to English in northern Louisiana.

However, for a linguist, this immense archive is at first disappointing. It reveals nothing directly about language change or variation or contact between French and English, or even opinions or perceptions about language. I have not yet found one comment on the replacement of French by English in the papers themselves. Yet the shift in language must have been meaningful to this family.

The people whose lives can be inferred from these documents formed a dense, multiplex network. The names of the most prosperous of the white creoles of the Red River area show up in the Prudhomme Family Papers. They were related by birth or marriage or both to creoles in this area and to others along the Mississippi River and in New Orleans and St. Louis. They were Catholics. Well into the twentieth century, they spoke and read and wrote French. The basis of the family's wealth was cotton. They owned slaves. Although they were wealthy, there were constant financial concerns, as the entire enterprise was subject to the vagaries of weather, flooding, and the price of cotton in Europe.

At the time of the Louisiana Purchase, the language of this extended family network was French. This remained true until the 1830s. The pattern for the first generation of Prudhommes after American acquisition is a preference for French in both personal and business affairs but a willingness to use English beyond their creole circle with government officials and other English speakers with whom they did business. This is the generation of Phanor Prudhomme, 1807–'65. Virtually all of his personal correspondence is in French, and so is a large portion of his business correspondence, mostly with cotton factors in New Orleans. But when he wanted to dispute a claim against his father's estate, to order an iron fence from New York, or to inquire about installing a new kind of cotton press, he wrote in English with the usage and fluency of a native speaker.

Phanor Prudhomme's older son and heir, James Alphonse, 1838–1919, left writings that show that he too knew both French and English well. English was his primary language, and he seems to have used French only for personal and family reasons. When he was away at school, Alphonse wrote his diary entirely in English.

Alphonse was one of a number of cousins of about the same age who grew up in the vicinity of Natchitoches during the 1840s and 1850s. They all knew French—some very well, as shown by school notebooks of lectures on French literature and by school compositions written in French. However, these young adults corresponded with each other in English and kept their diaries in English.

Strong, dense network ties usually favor conservatism in language, so why the abrupt change in linguistic allegiance? The close-knit network did support the retention of French but retracted it into the private domains of family and church. Economic prosperity for this family required going outside the closed creole network. And that required English.

The influx of English speakers westward across the Mississippi River after the Louisiana Purchase and the dramatic increase in the production of cotton created a situation in which prosperity depended in large part and increasingly on associations outside the creole network, associations carried on with monolingual English speakers. Linguist Michael Picone (2003) thinks that the large number of slaves required by cotton production forced

the importation of monolingual English-speaking slaves from other parts of the South and was likewise an important factor in the shift to English in the region.

The Red River creoles seem to have deliberately extended their network in an important way—in the education of their children. Although a few among the wealthy in Louisiana employed tutors for their children, beginning early in the nineteenth century the Prudhommes appear to have favored sending their children—both boys and girls—to boarding schools.

Because of the schools established by two French orders of nuns, the Ursulines and the Religious of the Sacred Heart, many of the girls remained in Louisiana, though the difficulties of travel at the time usually meant that they returned home only once a year, and sometimes not that often. A beautiful handwritten arithmetic book in the collection attests that one girl in the family attended the Ursuline school. It is inscribed 'Cahier d'Arithmétique fait par Lise Metoyer au couvent des Ursulines de la Nouvelle Orléans 14 septembre 1832' (Folder 111). At Ursuline schools in America, morning lessons were conducted in French and afternoon lessons in English (Aycock 1993:213). In 1821 the Religious of the Sacred Heart established a school for girls in Grand Coteau, Louisiana, followed by one sixty miles upstream from New Orleans on the Mississippi River in 1825, and one in Natchitoches itself in 1847 (Calan 1937:775–80). By the time of the Civil War there were also Sacred Heart academies in St. Louis and Manhattanville, New York, and at least one of the young women writers in the Prudhomme collection attended Manhattanville. All of the Religious of the Sacred Heart were under one superior general, and all of the private academies that they established followed the same Plan of Studies and held many of the same religious and cultural activities. The report card of Désirée Archinard Locoul, niece and ward of Phanor Prudhomme, from the school in Natchitoches in 1851 listed as subjects *Lecture française, Lecture anglaise, Grammaire française, Grammaire anglaise, Traduction anglaise,* and *Traduction française* (Gore 2001:144).[5] The nuns formed a network, keeping in touch with each other and moving from one foundation to another in obedience to their superiors. Although religious continued to come from France until the middle of the nineteenth century, the order early attracted some girls in their care to their way of life. A school girl of Irish heritage educated at Grand Coteau, Mary Elizabeth Moran, eventually took the Society to Puerto Rico and Mexico. Susannah Boudreau of Bayou LaFourche was the mistress general at Manhattanville at the time of the Civil War. Mary Ann Hardey became the first American to serve as second in authority at the motherhouse in Paris (Blish 2004:89). The Ursuline and Sacred Heart schools preserved and transmitted French language, culture, and devotional practices while preparing the girls to live as English-speaking American women.

Some of the generation of Louisiana creoles that came to adulthood in the 1850s were sent further away both physically and culturally than the convent schools of the Ursulines and Religious of the Sacred Heart. Many went to school in Bardstown, Kentucky, where the first Catholic diocese in United States territory west of the Alleghenies had been established and where boys could board at St. Joseph's and girls at Nazareth Female Seminary, founded by a new American order of nuns, the Sisters of Charity of Nazareth. The 1850 census for Nelson County, Kentucky, lists 120 females nineteen years and younger living at

the Nazareth Female Seminary. Of those, 29 (24%) show Louisiana as their birthplace (US GenWeb Census Project). At least three of the surnames—Bossier, Lambro, and Lecomte—are part of the Prudhomme family. The 1850 census reports 130 students in residence at St. Joseph's for boys, fifty-five of them (42%)[6] listed with Louisiana as their birthplace (*ibid*). At both schools most of the other students had Irish, English, or German surnames and came mainly from Kentucky, Mississippi, and Alabama. In schools outside of Louisiana, creole children learned English well and associated with the children of prosperous Catholics, often from other parts of the South. Two of the boys in the Prudhomme collection went to school in New England. Some even went to college, one to the University of North Carolina in 1858 and 1859 and his younger brother to Georgetown University.

The generation who came of age in the 1850s and 1860s were bilingual in French and English, but surviving writings show that as adolescents this generation preferred English. Although French appears to have been the language of home and church and although they studied written French in school, they wrote to each other and kept their personal journals in English.

Of particular human interest is a series of about thirty letters over a two-year period (1858–'59) from Coralie Buard to her cousin Fanny Bossier. They are all in English, with just a handful of French sentences and phrases. Fanny had just finished school in New York and was back home bored to death, as was Coralie. Here is an example (Folder 1):

> February 28/58
>
> My own dearest Fanny,
> I am sorry, yes indeed, very sorry, not to have met you at Grandma's. I am compelled to remain at Eliza's by Uncle Henry's will. This morning he was here and told me that if I positively refused to comply with his desire, he should force me to obey, and you know Fanny I need no such means to submit to my mother's command… I shall have to trample on my own heart to please others.

In very few documents are words of one language interspersed in the other. When this is done, it is usually for stylistic effect. The code-mixing in another letter from Coralie to Fanny is typical (Folder 1):

> Sept. 12, 1858
>
> There were no Creole gentlemen present, excepting our dear cousins (Herzog) and Felix. The party was gay and went off better than we had expected. John C.[loutier] was anxious to go, but on account of his brother's death he was obliged to sacrifice his pleasure. He was seen at the door and window during the party. *Ainsi, tu vois que son envie etait forte.*
>
> As for the fishing party last Thursday, we also enjoyed it better than we had expected in the company of American girls and gentlemen.

The content of letter (2) shows, however, that despite their schooling away from their French-speaking home and their use of English with each other, the young women still

consider themselves culturally distinct from the monolingual English speakers that by then formed the majority of the population of Northern Louisiana where they lived—still in 1858 referring to them as *American*.

Within two years of this correspondence, Coralie Buard married John Cloutier, and Fanny Bossier married Antoine Prudhomme. In the year of her marriage, 1860, Fanny kept an elaborate scrapbook (PA-613-1). It contains little French. However, sixteen years later, in August 1876, Fanny writes a note in French to her daughter Laurencia Lelia Prudhomme on the reverse of a picture of a Crystal Prismatic Illuminated Cross: 'Chère enfant, aime toujours ton parrain et soit digne de son amitié. Ta mère, F. Prudhomme' (Folder 771). ['Dear child, always love your godfather and be worthy of his affection. Your mother, F. Prudhomme'] Apparently, the special cross was a gift to Laurencia from her godfather, and her mother wanted to be certain that that information would not be forgotten. French was still the language of family intimacy, particularly pertaining to faith and piety. Some religious bookmarks in the collection continue to be in French toward the end of the nineteenth century.

For the Red River creole cousins who came to adulthood around the beginning of the Civil War, knowledge of French differentiated them from their 'American' neighbors, and knowledge of English gained by going outside their local network differentiated them from less prosperous monolingual French-speaking creoles and from the Acadians.

For this one, tight-knit creole family living in an area that increased in Anglophone population dramatically during the first half of the nineteenth century, bilingualism became one of properties of their network. The Prudhomme Family Papers show that both the first and second generations after the Louisiana Purchase were bilingual, with no evidence of imperfectly learned French or English, except in letters from children. The two languages were kept separate. The first generation stuck to French as much as possible, using English for economic reasons. Their children stuck to English as much as possible, using French mainly for reasons of family communication and solidarity. By the time of the Civil War, except for the church, French had disappeared as a public language in northern Louisiana.

1 The foundational documents of social network analysis in sociolinguistics are the two editions of Lesley Milroy's *Language and Social Networks,* in 1980 and 1987. Chambers (1995) and a 20-page essay by L. Milroy (2002) survey the scholarly work in social network analysis of the past two decades in the context of the major issues in sociolinguistic theory.

2 A workshop in conjunction with the 1998 International Conference on English Historical Linguistics took as its aim the application of social network analysis as developed by Lesley Milroy (1987) to older stages of the English language. The six studies from this workshop published in 2000 in the *European Journal of English Studies* give support to the Milroys' hypotheses about the role of strong and weak ties in language change.

3 In this essay, *creole* means 'native to the colony or descended from natives to the colony', i.e. in Louisiana before 1804.

4 In 1821 the Prudhommes moved into a new home on the banks of the Red River about thirteen miles out of Natchitoches. Subsequent generations lived there until the 1990s. In 1997 the

plantation house, outbuildings, and some of the land, known as Oakland Plantation, were taken over by the National Park Service as part of the Cane River Creole National Park.

5 Writing her memories for her children in 1935 and 1936, Laura Gore, Désirée's daughter, recalled about her mother, 'She sang and played delightfully and had perfect command of both English and French' (Gore 2001:24).

6 The high percentage of boys, as compared with girls, from Louisiana may be due in part to a reluctance to send girls so far away from home, but it may also be due to the fact that Catholic boarding schools established for young boys during the nineteenth century never achieved the cohesion or long term stability that those established by nuns for girls did. For creoles, too, another consideration could be that families were more willing to send males to schools with non-Catholics who would some day be their business associates, so males could attend private boarding schools that did not have a Catholic identity.

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THE EFFECT OF NEURODIVERSITY ON THE TRANSMISSION OF INFORMATION THROUGH LANGUAGE

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The degree to which behaviors, including language processing, may be hard-wired in the brain is still under investigation. Many functionalists are willing to concede that the brain is modular, without suggesting that language is hard-wired (Givon 2002). Instead, certain areas are considered to specialize in sequencing, while others mirror the actions of conspecifics and aid in perspective-taking. By and large, however, there is a general consensus that brain structure determines language function and that normal brain morphology is a prerequisite for language acquisition and use.

In this paper, we will explore examples of normal language development despite abnormal brain morphology. We will likewise distinguish between normal brain anatomy and typical neurofunction, and we will note cases where considerable differences in linguistically related neurofunction do not result in significant differences in language ability. We will see that individuals may perform a linguistic task normally but achieve their normal results in a neurologically abnormal manner.

The functional equivalence of significantly different neurophysiological profiles lead us to conclude that language is a communicative tool distinct from its specific neural embodiments.

1. Better cognitive function does not necessarily imply a more robust or healthier brain. On April 17, 1955, when Albert Einstein died of a burst aortic aneurysm at the age of seventy-six, Thomas Harvey, the pathologist on call that evening, harvested the physicist's brain in hopes of discovering a neurological correlate to Einstein's unusual cognitive abilities (Burrell 2005:276–97).

Harvey was not a brain specialist, and it took him many years until he found a researcher who was willing to collaborate with him on this project. Eventually, a UCLA neuroscientist named Marian Diamond proposed a comparative study involving cell counts from Einstein's brain and those of a number of carefully selected controls. The results of this study appeared in *Experimental Neurology* in 1985. The study involved sample blocks from Brodmann areas 9 and 39 in the left and right hemispheres of Einstein's brain. These blocks were from the association cortex, which according to Diamond *et al*. (1985:202), are 'the last domains of the cortex to myelinate, indicating their comparatively late development'.

Diamond counted individual neurons and two kinds of glial cells: astrocytes and oligodendrocytes. She then came up with four total counts: neurons, astrocytes, oligodendrocytes and combined glial cells. From the total counts Diamond constructed three ratios, comparing neurons per unit area to the number of glial cells in each count. She

then compared Einstein's counts and ratios to those of a control group consisting of eleven brains of former VA hospital patients, all men and all dead from non-neurological disorders. The average age of the control group patients was sixty-four.

The seven measures that Diamond constructed, consisting of four counts and three ratios, resulted in twenty-eight possible statistical comparisons. However, most of these turned out results that were disappointing. Diamond rejected all but the neuron-to-glial-cell ratio. She found it necessary to pool all glial cells counted to attain statistically significant results. This reduced the twenty-eight possible tests to four. Of these four, Einstein differed significantly from the control group only in Brodmann area 39 of the left hemisphere in which he had a much lower neuron-to-glial-cell ratio. (Diamond *et al.* 1985:201) Since glial cells, in their capacity as support cells for neurons, continue to divide throughout one's lifetime, while neurons do not, there are only two ways in which neuron-to-glial-cell ratios can increase. Either neurons die off or glial cells increase. Diamond *et al.* (1985:203) concluded that the lower neuron-to-glial-cell ratios in Einstein's brain 'suggests a response by glial cells to greater neuronal metabolic need'. In other words, Einstein's thinking required so much energy that the number of glial cells necessary to support a single neuron rose dramatically.

Diamond's conclusion has since been discredited (Hines 1998). In any event, there is a much simpler explanation for the results that Diamond came up with. Biographical evidence confirms Einstein's own recollection that he began speaking late, after age three, and that he appeared inarticulate and possibly dyslectic through his early school years. Kantha (1992, 1996) of the Osaka Bioscience Institute in Japan concluded that Diamond's cell counts indicate that Einstein's brain may have suffered some kind of lesion in Brodmann area 39 in the left hemisphere, an injury which may have resulted in childhood dyslexia.

In other words, not only did Einstein not possess a superior brain, his brain may have actually been defective. Better cognitive function does not necessarily imply a more robust or healthier brain. (Despite the failure of Diamond's study, similar research is still being conducted on Einstein's brain. More recently Witelson *et al.* (1999:2149) published an article in the *Lancet* entitled 'The exceptional brain of Albert Einstein'. They focused on the morphology of the Sylvan fissure, which in Einstein, they claimed, is 15% wider than in controls.)

From the study of savants we have learned that in many cases, exceptional ability in one area goes hand in hand with severe deficits in other areas. This evidence has been adduced to support the claim for the modularity and hard-wired quality of language, where the savant is exceptionally gifted in language. Conversely, where the savant has severe deficits in language, this is thought to bolster the claim that language processing ability is a completely localized and hard-wired brain function, which can be completely disrupted by focal brain injury (Bates 1997). But Einstein, as an adult, did not have a speech impediment, and he was not at all inarticulate. The damage to his Brodmann area 39 suggests that he may have used some other area to process language, and that using this alternate method did not in the end cause him to have a language handicap. Instead, this atypical neurological function may have given him an advantage in general cognition.

The question we must explore, then, is whether the findings in this and similar studies support the idea that the brain is entirely modular, and that a focal injury in a particular region will necessarily disable the function for which that region is responsible. In the next section we will explore studies that address this point directly.

2. LATERALIZATION, INJURY, SEX AND AUTISM: TYPICAL NEUROFUNCTION DOES NOT STRICTLY DETERMINE TYPICAL LANGUAGE FUNCTION. Studies on cerebral lateralization support the idea that there is standard dominance pattern: strong left hemisphere dominance for language and handedness and strong right hemisphere dominance for non-linguistic functions such as visual and spatial abilities. In the general population, 95% of right-handed people have language lateralized to the left hemisphere. In the left-handed population, lateralization of language to the right hemisphere is more common (about 25%), but left-handers show reduced language laterality effects. That is, there is a smaller difference in how quickly left-handers respond to stimuli presented to their left or right ear or visual field. The degree of left hemisphere dominance is greater in males than in females (Baron-Cohen 1999:413–14).

Complex sex-by-laterality interactions have been noted:

> Right handed males perform better on spatial tests, but worse on verbal tests, relative to left-handed males. Right handed females perform worse on spatial tests, but better on verbal tests, relative to left-handed females. (Baron-Cohen 1999:414)

Baron-Cohen (1999) has suggested that there is a continuum of 'brain types': female, male and autistic, in which those suffering from Autism Spectrum Disorders (ASD) find themselves in the extreme male side of the continuum, regardless of their actual sex. The evidence he lists in order to support this theory is as follows (ibid:414–15):

(i) Normal males are superior to normal females in spatial tasks, and people with ASD are even better at spatial tasks.
(ii) There is a strong male bias in the sex ratio of ASD.
(iii) Normal males take a longer time to acquire language than normal females, and children with autism are even more delayed in acquiring language.
(iv) Normal males are behind normal females in developing socially, and people with ASD even more so.
(v) Normal females are superior to normal males in mind-reading tasks, and even more superior to people with ASD.
(vi) Normal males have a smaller corpus callosum than normal females, and people with ASD have an even smaller one.
(vii) Males are more likely to be left handed, and people with ASD show a higher incidence of left-handedness.
(viii) Normal males have heavier brains than normal females, and people with ASD have even heavier brains than normal males.

The one piece of data that runs counter to the theory is that people with ASD are less lateralized than normal males, and normal females are also less lateralized than normal males. (Baron-Cohen 1999:415) This could be explained in terms of sinistrality, in that left-handed people in general are less lateralized than right-handed people, and there is a higher incidence of left-handedness among those with ASD.

Baron-Cohen suggests that the male and female brain types (regardless of genetic or anatomical sex) are determined prenatally, by exposure to varying levels of testosterone in the womb. 'Levels of prenatal testosterone (as assessed during amniocentesis) predict spatial ability at follow-up at age 7' (Baron-Cohen 1999:412).

From all of the above we may conclude that significant differences in lateralization, and in language dominance, can be found within the general population, based on levels of testosterone to which an individual may have been exposed in the womb. That is to say, which part or parts of the brain are used in processing language varies according to prenatal hormonal effects.

The implications for language modularity within the species as a whole may not be immediately evident until we look more closely at how lateralization is affected by brain injury. Springer *et al.* (1999) reports a study of a semantic asymmetry activation task involving 100 right-handed neurologically normal subjects and 50 right-handed epilepsy patients, using MRI. They found that there was a continuum of activation asymmetry. Of normal subjects, 94% were left-hemisphere dominant for language, while 6% were bilateral. None of the normal subjects were right dominant for language. Among those with epilepsy, 78% showed left hemisphere dominance, 16% showed a symmetric pattern and 6% showed right hemisphere dominance. 'Atypical language dominance in the epilepsy group was associated with an earlier age of brain injury' (Springer *et al* 1999:2033).

The younger one is when injured, the better one is able to compensate for the damage by rewiring language functions in a different location.

However, so far, all we have been considering is the use of either side of the brain for language, and one might assume that the two sides being virtually symmetrical, there might be a potential language module on either side that can be selected as needed. Such evidence therefore does not completely discredit the language module theory of language acquisition and processing.

However, there is evidence from survivors of hydrocephaly that language function, unlike visual ability, is extremely malleable. Despite damage to the main language centers, many have normal language function. Cerebral blindness is more common in such cases than language disability. This suggests that visual processing is much more hardwired than language (see Alexander 1990, Bates *et al* 1999).

Normal language function despite abnormal brain morphology indicates that the phenomenon that we know as language is not directly dependent on any one 'correct' wiring diagram for the brain. Gaffrey *et al* (ms., 2005) demonstrated by fMRI and a semantic decision task that subjects with ASD performed comparably with normal subjects, despite showing a very different activation pattern. Normal subjects had significant activation for semantic decision in the left inferior frontal gyrus and sulcus (areas 44 and 45):

> Corresponding activation in the autism group was more limited, with smaller clusters in left inferior frontal areas 47 and 45… Autistic patients showed significantly greater activation than controls in bilateral extrastriate visual cortex (areas 18 and 19). Such greater than normal occipital activation in autisms suggests an important role of non-linguistic components (possibly visual imagery) during semantic decision. (Gaffrey *et al*. ms. 1)

The ASD group took a little more time to answer and were very slightly less accurate in their responses, but the differences would not have been significant in a general population not matched for IQ:

> Although a clinical population may be able to perform on a task, this may be achieved in an abnormal manner. Behavioral measures of accuracy and reaction time alone may not detect such abnormality, whereas neuroimaging can demonstrate distinct neurofunctional patterns… Our findings suggest that language profiles in ASD may differ from normal in relatively subtle ways on the behavioral level, whereas such differences are more distinct on the neurofunctional level. (*ibid* ms. 8)

Restated, this means that even though a person may speak normally, his brain may not be wired in the same way as that of another person who also speaks normally. During typical interpersonal transactions involving language, without access to data from fMRI, individuals are unaware of the neurological differences.

The question we must now address as linguists is this: what defines normal language, communicative function or neurological function?

3. LANGUAGE AS CODE: IN THE ABSENCE OF THEORY OF MIND, LANGUAGE STILL TRANSMITS INFORMATION. The literature on ASD suggests that there is a continuum along the autism spectrum and that many fully functional human beings, some of whom have never had any communicative problems with language or even socialization, can be proved to be further along the autism spectrum than other equally functional human beings with normal language ability (Baron-Cohen 1999.415). If we were to judge language as its neurofunctional embodiment and measure language ability as against a neurological norm, many perfectly able human beings would be blackballed as not really possessing language. That such an outcome would have undesirable social effects is not the main focus of this section, but the problem is readily apparent.

Language is a code whereby one thing stands for something else in transmitting information. Exactly how the encoding or decoding is achieved by each individual is beside the point. Speaking the same language creates the illusion that our brains must be wired the same. Language bridges the gaps between individual cognitive and neurological differences and allows very different minds to communicate.

Autism and ASD are linked to deficits in Theory of Mind (TOM) (Baron-Cohen 1999), deficits that are shared by non-human primates (Povinelli 2004). TOM is what enables us to deduce the mental states of others and act accordingly, in order to manipulate others

into doing what we want. It accounts for socialization, Gricean maxims and speech acts, and many other aspects of pragmatics. The absence of TOM creates difficulties in language acquisition, but 'language becomes more autonomous' from TOM 'in later stages of development... Some autistic children are able to catch up on their language skills in later years without overcoming their deficit' in TOM (Malle 2002:271).

In chimpanzee language studies, some skeptics observe that the same behavior on the part of a chimpanzee (e.g. asking for a banana) may be motivated by different cognitive processes than those of a human child. The chimp may simply have observed that asking for a banana is closely followed sequentially by getting a banana, whereas the human child is thinking, 'what can I do to make Mommy think that maybe she should give me a banana?' I am not suggesting that such differences do not exist. The point of this paper is that they ultimately do not matter if the subject under discussion is language rather than psychology or neurology.

The degree to which language use is socially motivated varies from individual to individual in the human population, and deficits in TOM are also not uniform among chimpanzees. Povinelli (2004) may have shown us that four out of five young chimpanzees are unaware that 'seeing is knowing', but what does this say about the fifth chimpanzee?

Ultimately, we are as guilty of anthropomorphizing our fellow man as we are with other primates, if by anthropomorphizing we mean ascribing to others the same thoughts and feelings that we ourselves would experience under the same circumstances. This drive to anthropomorphize is especially strong in those with a functioning TOM but non-existent among the mindblind members of the ASD population.

If we look at language as primarily a means to transmit information, then we will see that analyzing the states of mind of others is a secondary consideration. Information can be transmitted intentionally or unintentionally. Unintentional expressions, such as body language and involuntary vocalizations, can be just as effective as intentional communication, and in all likelihood preceded manipulative uses of naturally occurring expressive signals. Many such signals work to the detriment of the individual emitting them but to the benefit of the group and are probably selected for by survival not of the speaker, but of closely related hearers.

From an evolutionary point of view, language probably arose out of the food and warning cries still prevalent in the simian population. A capuchin monkey who spies a particular fruit emits a cry that informs others that the fruit is available. The cry may or may not be voluntary, it may arise as an expression of the monkey's joy at the find, and he may in fact suffer from alerting others of the find, since there will that much less left for him and stronger members of the group will get the better specimens of fruit, leaving him with less tasty morsels. A monkey, upon spotting a particular predator emits another kind of cry, warning the others of the danger. He may not have intended to warn the others; it may be a spontaneous expression of his fear. He may suffer from having made the noise. The predator may spot him and kill him; it might have been wiser to stay quiet.

People without a TOM never cry wolf. When they speak, they are transmitting information without any concern for how another individual may use the information transmitted.

Before there can be speech acts and lying, euphemisms and metaphors, there has to be a literal level on which language is simply code that transmits information about the world.

It may be the case that individuals with ASD are the guardians of that primary aspect of the language code. It has been noted that people with Asperger's syndrome (a high functioning form of autism) have pedantic tendencies even in childhood. Their speech sounds more formal, more stilted, more archaic. They object to slang, grammatical irregularities and figurative language. They ignore the connotations of a word, relying on denotation alone. They never second guess what the speaker may have meant; they pay attention to what he actually said, like computers.

Without a TOM to guide them, people with ASD are more linguistically conservative, and it is likely that a language whose speakers are primarily of that ilk will not change as rapidly as one with neurotypical speakers. There will be no occasion for context induced reinterpretation, bleaching or other forms of grammaticalization, since most of these changes occur when hearers try to guess what speakers really mean.

4. CONCLUSION. Language is a code for transmitting information. It is a tool for encoding information distinct from its diverse neural embodiments. Neurological function within the human population shows great variation, but language transcends these differences and allows information to flow freely. Language unites us despite our biological differences.

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ENCODING SYNTAX IN RHYTHMIC NEURAL NETWORKS

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LexisNexis

Perhaps the most celebrated debate in the annals of psychology and cognitive science was Chomsky's unrebutted 1959 review of B. F. Skinner's *Verbal Behavior*. In fact, however, the crux of Chomsky's argument was first made by Harvard Professor of Psychology Karl Lashley in 1951 (Lashley 1951). Lashley's incisive critique was grounded in behaviorism's inability to explain how the Rev. William Spooner, on rising to honor the queen, offered a toast 'To our queer, old dean'. Lashley's point was that metatheses like Spoonerisms pervade our everyday behavior, from tpyographical errors [sic] to the varying order in which we might don our clothes in the morning to musical improvisations. If these behaviors had in fact been learned as the stimulus-response chains of behaviorist theory, no such metatheses would be possible.

Unfortunately, Lashley's analysis was remembered more for its wit than for its wisdom. It fell to the young Noam Chomsky, then a Junior Fellow at Harvard, to find an example no one could dismiss as trivial or eccentric. Chomsky (1957) presented a theory of transformational grammar by which a sentence like *John kissed Mary* could be generated by recursive rules, represented in a tree structure, and then metathesized to yield *Mary was kissed by John*. Shortly thereafter Chomsky joined forces with MIT computer scientist John McCarthy, who implemented the computer language Lisp on a pushdown store automaton to model Chomsky's theory. Armed with examples of transformational grammar, an un-chain-like tree representation of syntactic structures, a theory of recursion by which to generate tree structures, and a computational system with which theories could be modeled and tested, a new psychology was born, a psychology of Psycholinguistics that promised to replace the totalitarian determinism of behaviorism with the democratic freedom to metathesize.

Unfortunately, Miller and Isard (1964) showed human beings had difficulty processing center-embedded sentences like *The rat the cat the dog chased ate died.* But McCarthy's Lisp machines had no such difficulty. Psycholinguistics had a decision to make. Rather than conclude the theory was wrong, psycholinguists at the time decided that humans simply had processing limitations that computers didn't have. Psycholinguistics gave way to Artificial Intelligence, the Überpsychologie of the digital computer.

By the mid 1980s, this theory had also failed. Artificial Intelligence had created computers that could beat grandmasters at chess. But change one rule and let the Queen move but one space at a time as in the old rules of the game, and even a ten-year-old could beat a million dollar computer. Most researchers soon came to believe that neither a Grammar nor an Überpsychologie could be founded upon a few, primitive, innate rules; rather an intelligent mind had to be able to *learn*. With this new insight, the recursive, rule-based model of the pushdown store automaton was discarded and a new psychology was born.

The new Cognitive Science began as an amalgam of previous theories but soon came to be based largely on the model of **neural networks**.

One might have expected the neural networks of Cognitive Science to be modeled after human cerebral cortex—the brain region in which most of cognition was known to occur—but this did not happen. Only a few cognitive scientists (notably Lamb 1999) bothered to consider the biology of the cerebral cortex. Instead the dominant new models of Cognitive Science were **hidden Markov models**, which were drawn from physics and easy to implement on digital computers. These models could be construed to be neural models because they bore a superficial resemblance to the human cortex. Unfortunately, however, they resembled the cortex of the cerebellum, not the neocortex of the cerebrum (Loritz 1991). The models could learn English past tense verb forms in a fashion similar to children, but if they then were taught French past tense verbs, the French would soon corrupt and erase the learnt English—a behavior wholly unlike the behavior of humans and maladaptive to the point of extinction for an organism that depends upon learning to survive natural selection.

So it happened that, by the year 2000, psychology and linguistics had gone full-circle, from models of Skinnerian stimulus-response chains to computer models of mind based on Markov chains. Even Chomsky found himself conceding that 'the basic elements of a [syntactic] representation are chains' (Chomsky 1995). Spoonerisms and most of the significant linguistic issues raised in the previous 50 years remained unexplained.

While some cognitive scientists disregarded neurobiology on the grounds that the human brain has undesirable processing limitations, others did so on the grounds that nobody really knows how the brain works anyway. However, by 1981 some twenty-five Nobel Prizes had been awarded in the brain sciences, and Stephen Grossberg (1972, 1980, *passim*) had synthesized this work into his Adaptive Resonance Theory (ART). Unfortunately, Grossberg expressed his model in a sophisticated mathematical model of differential difference equations that had a 'reputation for difficulty' even among computer scientists (Anderson & Rosenfeld 1988).

Grossberg's ART was developed with considerable attention to experimental psychology and vision, but with little reference to language (and absolutely no deference to how easily it could be implemented on a digital computer). Loritz (1999) applies ART to language and language learning, and it is within this **Adaptive Grammar** (AG) framework that the remainder of this paper is written. Few readers are likely to be familiar with the neurobiological, mathematical, and psychological foundations upon which ART was built, so Sections 1 through 9 supply a compressed and necessarily somewhat dense summary of ART dynamics with short linguistic examples. Sections 10 through 12 outline the promised rhythmic theory of syntax. The specific linguistic conclusions reached have been reached before by different theories (e.g. Sullivan 1980). The value claimed for the particular conclusions of the present study is that they are derived from a theory of what is human about mind and brain.

1. ON-CENTER OFF-SURROUND ARCHITECTURE. Neocortical **on-center off-surround** (OCOS) cytoarchitectures have a long research history, dating back to Ramon y Cajal's 1906

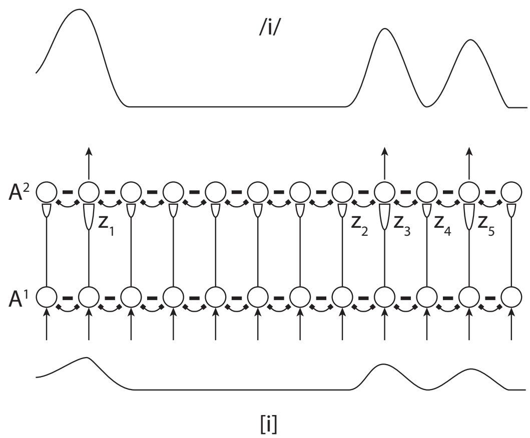

Figure 1. *OCOS phonemicization.*

Nobel Prize, and including Mountcastle's (1957) discovery of neocortical columns. In 1967 Hartline received the Nobel Prize for his work on similar architectures in vision, and this was a point of departure for Grossberg's early work.

To begin to understand the role of OCOS architectures in speech and hearing, consider that the mammalian auditory tract is organized *tonotopically*. That is, from the cochlea up through neocortex, the neurons of each stage of the auditory tract are arrayed like a piano keyboard, receptive to frequencies from low to high. **Figure 1** schematizes the output dynamics of such a field of OCOS neocortical columns. In **Figure 1** the input phone [i] activates a tonotopic column field in A^1 (primary auditory cortex).

The column at the center of each input formant of [i] excites itself (on-center) and inhibits its neighboring columns (off-surround). The resulting output to A^2, a second field in the auditory cortex, is the contrast-enhanced phoneme /i/.

Although this paper will be primarily concerned with the neocortex, OCOS dynamics also occur elsewhere in the nervous and endocrine systems as evolutionary extensions of Sherrington's (1909) model of agonist-antagonist pairing, most notably in the thalamic reticular formation (proto-neocortex) and the lateral (vision) and medial (hearing) geniculate nuclei of the thalamus.

2. SYSTEM DYNAMICS. AG applies the following ART-derived dynamics to the anatomy of **Figure 1** and to all subsequent figures and models.

(i) $d/dt\, x_j = -Ax_j + \Sigma_i Bx_i n_{ij} - \Sigma_k Cx_k n_{kj}$

(ii) $d/dt\, z_{ij} = -Dz_{ij} + Ex_i x_j$

(iii) $d/dt\, n_{ij} = +Fz_{ij} - Gx_i n_{ij}$

While interesting mathematical inferences flow from Grossberg's system, one need not be a mathematician to appreciate the basic behaviors these equations describe:

Equation (i) describes how the short-term memory (STM) trace (activation level) of a cortical column x_j changes with and without various inputs. The term $+\sum_i Bx_i n_{ij}$ says that x_j is excited at rate B by the sum ($\sum$) of excitatory input signals from columns x_i. These signals are modulated by the available neurotransmitter n_{ij} at each corresponding synapse z_{ij}. The term $-\sum_k Cx_k n_{kj}$ says that x_j is inhibited at rate C by neighboring columns x_k. In the absence of excitatory or inhibitory signals, x_j simply decreases (forgets) at rate A. Equation (i) is a is a transform of the Hodgkin-Huxley (1952) membrane equation. Equation (i) mathematically explains the ionic conduction of nerve signals, which are propagated by ions opening and closing **molecular gates** in the neuronal membrane. This formulation earned Hodgkin and Huxley the 1963 Nobel Prize in Medicine.

The rate functions A–G in equations (i)–(iii) are chosen to be *sigmoidal* ('∫-shaped'). This guarantees that just as a neuron can never be more inhibited than when all its membrane gates are closed nor ever more active than when all its gates are open, so too the equations (i)–(iii) can remain mathematically bounded between 0 and 1.

Equation (ii) says that the long-term memory (LTM) trace z_{ij} forgets at rate D and learns at rate E iff $x_i > 0$ and $x_j > 0$. That is, if either x_i is inactive or x_j is inactive, then the product $x_i \cdot x_j = 0$, and no learning occurs at z_{ij}. This equation integrates Hebb's famous learning rule into Grossberg's system: '…if neuron A repeatedly contributes to the firing of neuron B, then A's efficiency in firing B increase' (Hebb 1949). (In **Figure 1** and elsewhere, larger and smaller axon terminals [sometimes called **synaptic knobs**] illustrate larger and smaller LTM traces.]

Equation (iii) says that the available neurotransmitter n_{ij} at any synapse z_{ij} is synthesized at a rate F, a function of the synaptic capacity (the LTM trace) z_{ij}, and n_{ij} decreases at rate G, a function of the neurotransmitter released in response to input from an x_i.

Many psychological conditions can be modeled by choosing different values for A–G. For example, very large A provides a model of Alzheimer's Disease. Very large B provides a model of grand mal epilepsy. Very large C provides a model of petite mal epilepsy. Of course this is a vast over-simplification since, *in vivo*, all such syndromes involve more than a single factor. But as we explore linguistic inputs to OCOS networks, equations (i)–(iii) help define a system that can learn language, use language, and adapt language to new and ever different purposes.

3. SELF-SIMILARITY LEMMAS. $x_j \equiv X^j$: a distributed field of active x_j columns X^j behaves in a manner self-similar to a single column x_j. Similarly, $z_{ij} \equiv Z^{ij}$ and $n_{ij} \equiv N^{ij}$. Then equations (i)–(iii) hold at all neocortical scales from neocortical columns to fields as large as whole cerebral hemispheres. Uppercase notation is henceforth used only to emphasize descriptions of dynamics at field scale. Normally, we use lowercase to represent both individual-column and column-field dynamics. **Figure 2** illustrates this principle of self-similarity.

In **Figure 2a** a simple pattern is projected to a simulation of neocortex. Because the axons of large pyramidal cells at the center of neocortical columns can project many centimeters to distal columns, this pattern becomes distributed across many distal columns (**Figure 2b**). **Figure 2b** also shows how the original pattern can become enhanced: resonant feedback

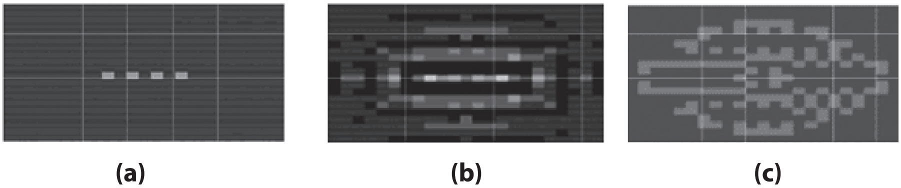

Figure 2. *(a) An input pattern, (b) OCOS resonance creates signal enhancement and edge detection, (c) activity is complemented by a 'rebound'.*

from the distal columns causes the signal at the original input pattern to become amplified, even as activity in the signal's immediate surround is attenuated.

At the edges of the original pattern in **Figure 2b**, the signal is especially enhanced. Like contrast enhancement, this **edge detection** is a highly valuable signal-processing feature that comes for free in OCOS anatomies. Edge detection arises because the columns in the middle of the input are inhibited by **on** columns on both sides, whereas columns at the edges of the input are inhibited by columns on only one flank.

The dynamics of such paired **on-off** columns are particularly interesting. Such pairs form a **minimal anatomy** called a **dipole**. We will look closely at dipole dynamics in the following sections. Here, **Figure 2c** illustrates how, by self-similarity, the entire distributed field can function as a single dipole. When inputs are turned off, a **dipole rebound** occurs. By equation (iii) above, neurotransmitter at active columns has become depleted, allowing neighboring, previously-inhibited columns to gain competitive advantage: across the field active columns are turned off and inactive columns are turned on. This flip-flopping of activity is referred to as a (dipole) **rebound**.

4. DIPOLE REBOUNDS. The reader may recognize dipole rebounds in the form of retinal afterimages perceived in response to a flash of light or upon closing one's eyes during bright illumination. In fact, these afterimages are instances of the McCullough effect. They do not arise at the retina but rather are generated at the lateral geniculate nucleus of the thalamus, the pre-neocortical processing stage of the visual tract, where red and green afferent signals compete in dipole opposition. In **Figure 3a** (overleaf), under red stimulation, the red pole dominates and sends a *red* percept to the neocortex. After some time, let nonspecific arousal (NSA, here a burst of white light with energy at all colors of the spectrum) innervate both the red and green poles. Since the neurotransmitter has been previously depleted in the red pole, the green pole can now dominate and a *green* percept can emerge at neocortex.

Note that rebounds can also occur by turning off all inputs, in this example by closing the eyes. Oscillatory dipole rebounds are also common. The wake/sleep cycle of our circadian rhythm imposes a global rebound on neocortex. When we walk, large numbers of neurons oscillate between the left and right hemispheres in patterns corresponding to the motor plan for walking. This latter **dipole clock** plays a critical role in syntactic behavior.

5. DIPOLES AND CATEGORICAL PERCEPTION. As we have seen, any two adjacent x_j or X_j form a dipole (Grossberg 1972, 1980). In **Figure 3b–c** (overleaf) we model a thalamus-A^1

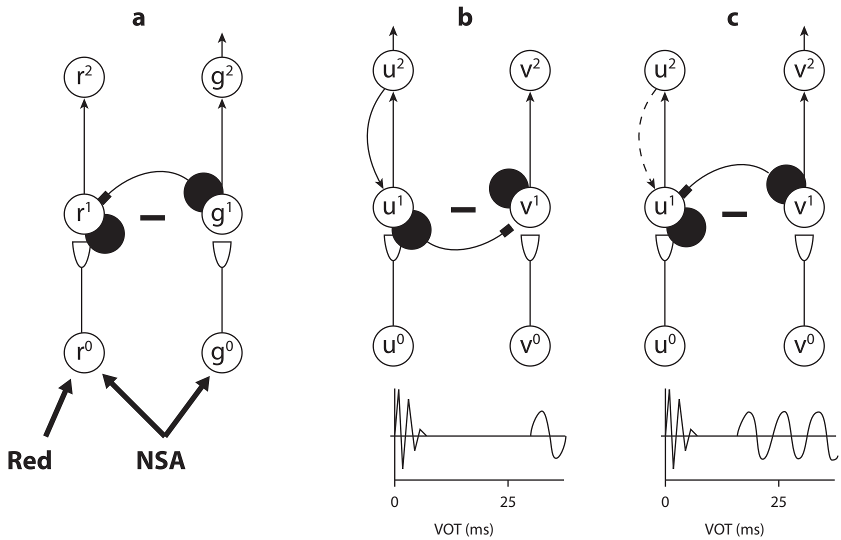

Figure 3. *Nonspecific arousal can cause a dipole rebound.*

dipole to explain the categorical perception of plosives. Eimas *et al.* (1971) awakened considerable scientific interest in innateness hypotheses of language by showing that even human neonates could categorically discriminate speech syllables like /ba/ and /pa/. However nativist philosophers quickly lost interest in the phenomenon when Kuhl and Miller (1975) showed that the same task could be performed by chinchillas.

In **Figure 3b** a plosive burst at $t = 0$ excites octopus cells in the mammalian cochlear nucleus (u^0). Octopus cells are an exception to the tonotopic principle. They receive inputs from all frequencies and so can respond quickly to events like plosive bursts. Octopus cell signals project up the auditory tract to thalamic column u^1. u^1 inhibits thalamic column v^1 while it also excites neocortical column u^2. u^2 reciprocally excites u^1. When voicing onset occurs at $t > 25$ ms, v^1 is already inhibited and thus v^0 cannot excite v^1, much less v^2. In the absence of inhibition from v^1, the u^1–u^2 resonance drives u^2 to threshhold, and an unvoiced plosive is perceived at A^1 in the neocortex. In **Figure 3c**, voicing onset begins at $t < 25$ ms. Before u^1–u^2 resonance can be established, v^1 inhibits u^1. Now persistent voicing at v^0 establishes a voiced plosive percept at neocortex. It is possible that this instance of categorical perception is largely or wholly computed by inhibition at the level of neocortex, but a thalamico-cortical model comports well with the more-intensively studied McCullough effect. Also, in vivo electrode verification of the implied cortico-thalamic pathway timings has been made in (mammalian) bats by Suga *et al.* (1997).

6. STABILITY AND PLASTICITY. It is instructive to consider **Figure 3** in light of equation (ii). In **Figure 3b** learning can occur at the u^0–u^1 synapse because, per Hebb's rule, both the pre- and post-synaptic neurons are active. However, in **Figure 3c**, u^1 is inhibited, so equation (ii) takes the following form:

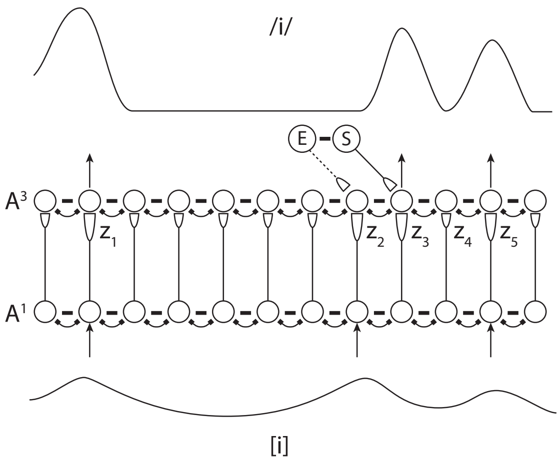

Figure 4. *Phonemic code switching.*

(ii') $d/dt\, z_u = -Dz_u + Eu^0 o$

I.e., u^1 is zero, so z_u *cannot learn*. This means that old learning at z_u is protected against accidental overwriting by new inputs. In general, rebounds turn off what is active (what we've already learned) and turn on inactive subnetworks to learn new inputs. This is significantly different from the behavior of non-ART neural networks, whose architecture is not cerebral. Such networks are plagued by saturation or adventitious recoding: new inputs start overwriting old learning. This is emphatically not how the human brain works: when an English speaker begins to learn French, the newly learned French does not erase previously-learned English. This is because English and French are maintained in competitive dipole fields: when one field is active, the other is shut down and cannot learn context-inappropriate inputs.

7. CODE SWITCHING. Although inactivated fields cannot learn, widely distributed rebounds can occur in milliseconds. Thus bilinguals can fluently switch between languages, for example inserting Spanish words into English sentences. Referring to **Figure 4**, imagine a Spanish-English bilingual, who must map the phones [i] and [ɪ] to the phoneme /i/ in Spanish, yet distinguish them in English.

Figure 4 shows a **balanced** bilingual (with $z^2 = z^3$) who has learned an *E-S* dipole that connects to A^2 (secondary auditory cortex) as diagrammed. Let the phone [ɪ] (characterized by a lower second formant peak, projecting to z^2) be instantiated at a tonotopic map at A^1. If Spanish is being spoken, supplementary input from the *S* pole causes the perceived formant peak at A^2 to shift upward to /i/. If $E > S$, supplementary excitation from *E* leaves [ɪ] unshifted in its projection to /ɪ/ at A^2.

8. LEARNING SERIAL ORDER IN A PARALLEL ARCHITECTURE. The parallel, OCOS architecture of the human neocortex is not well-designed for learning invariant serial order.

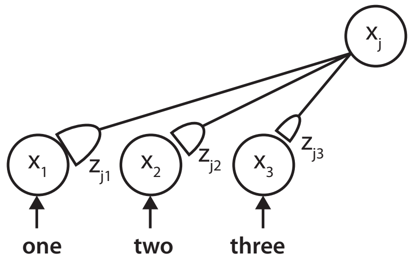

Figure 5. *Learning primacy sequences.*

Consider, for example, how children learning to count often make errors like *one, two, three, eight, nine, ten*. The first half of this sequence is an example of the well-known primacy effect: early items in a list are remembered best. The ART account of the primacy effect is diagrammed in **Figure 5**, where site x_j samples the input sequence *one, two, three*. (We could say x_j learns the sequence, but technically learning will occurs at the synapses z_{j1}, z_{j2} and z_{j3}.) When *one* is presented to x_1, it becomes active. x_j and x_1 now both being active, LTM learning begins at z_{j1} per equation (ii). Simultaneously, x_1 begins to inhibit neighboring columns x_2 and x_3 per equation (i). Thus, when *two* and *three* are subsequently presented, x_2 and x_3 each become less activated than its predecessors. It follows by equation (ii) that the LTM traces z_{j2} and z_{j3} are also each less highly activated than *their* predecessors. Thus the input sequence *one, two, three* becomes encoded in the STM activation pattern $x_1 > x_2 > x_3$ which is in turn remembered (learned) in the LTM pattern $z_{j1} > z_{12} > z_{j3}$.

Now if x_j's learning of the sensory inputs *one, two, three* is paired with learning of an analogous motor pattern $z_{j1}' > z_{j2}' > z_{j3}'$ (i.e., if the child repeats *one, two, three* as he hears it), then x_j can simultaneously also encode this LTM pattern as a **motor plan**. To perform this learned motor plan, the child need only activate x_j. Even though the synapses of the motor plan are activated in parallel, *one, two, three* will be output serially because $z_{j1}' > z_{j2}' > z_{j3}'$.

Similarly, at the end of the child's performance of *one, two, three, eight, nine, ten*, we observe a **recency effect**: the end of the list has been learned, but the middle has not. This is a serial manifestation of the edge detection dynamics we first examined in **Figure 3c**. (There is no *eleven* to inhibit *ten*.)

The foregoing is an elegant solution to the problem of learning serial order in a parallel anatomy, but there are three problems with this simplified account. In the first place, on readout x_1' should begin inhibiting x_2' as soon as *one* is spoken. So how can x_2 ever get started? What is to prevent x_1 from perseverating? What is to prevent the anatomy from stuttering *one, one, one*...? We need a neural subsystem that *deperseverates* x_1'—but only on (motor) readout, *not* during learning. It turns out that the cerebellum is just such a system, and we see below how cerebellar deperseveration affects the readout of a linguistic motor plan.

The second problem asks why, since $z_{j10} > z_{j9} > z_{j8}$, the child doesn't perform *one, two, three, ten, nine, eight*. It turns out that the surround of the inhibitory neurons of neocortical columns is only about 0.5 mm. (Contrast this with the excitatory surround of the large pyramidal cell of a cortical column, which can be scores of millimeters.) This means that the inhibitory surround of a cortical column is about four columns. This calculation

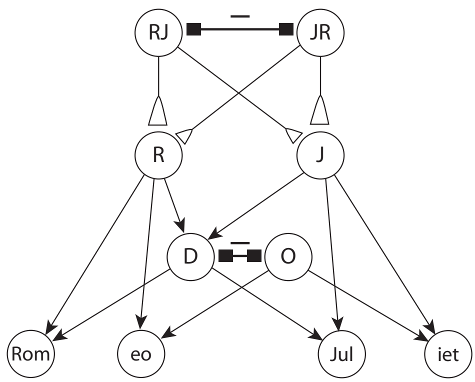

Figure 6. *Romiet and Juleo.*

neuroanatomically reduces Miller's (1956) **Magic Number Seven** to a number more on the order of four: to be learned or performed, longer sequences must be **chunked** into sequences of four or fewer.

9. ROMIET AND JULEO. As *Chorus* in a group reading of *Romeo and Juliet*, I once read the closing couplet aloud, *'For never was a tale of more woe [Chorus dramatically closes book]/ than this of Romiet and Juleo'.* **Figure 6** illustrates how the rhythm of phrase- and foot-dipoles clocked this Spoonerism. In **Figure 6** the phrase dipole opposes *Romeo and Juliet* (the name of the play) and *Juliet and (her) Romeo* (the last line). Book closed, I selected the normal phrase-plan *RJ*. By the serial order mechanisms just described, the learned plan *RJ* assigned primacy to *Romeo*. My foot-clock was set to the Downbeat, so I uttered *Rom* as the first syllable. I then realized that my plan was destined not to rhyme. A burst of nonspecific arousal rebounded the phrase dipole to plan *JR*. *JR* assigned primacy to *Juliet*, but my foot-clock was set to the Offbeat, so I said *iet*. My foot-clock now switched to the downbeat, and with *Juliet* as the still-activated word plan, I next uttered *Jul*. This completed the word *Juliet*, so *Romeo*, the second element of the invariant *JR* plan activated. But my foot-clock was now on the offbeat, so I uttered *eo*. Thus ended the tragedy of *Romiet and Juleo.*

10. SYNTAX. The serial order of clauses is governed by the same walking-dipole/foot-clock and its multiples. In the main clause of **Figure 7** (overleaf), these clocks order alternation between the *Topic* and *Relation* primacy gradients. The Topic (or nominal) gradient *T* is universally principally determined by STM. That is, it is principally determined by discourse. In **Figure 7** we are given the primacy gradient *Plum* > *White* > *hall* > *knife*. The *Relation* gradient *R* is a learned gradient. For English, as in **Figure 7**, *R* has learned the canonical order $V > Arg_1 > \ldots > Arg_n$, where the Arg_n are arguments to the verb. Inflected languages exploit learned relationships to the Verb, such as are sketched in **Figure 7** on *kill*.

In the motor readout of **Figure 7**, *Plum* is the most active node in the *T* gradient, because it is the presumed topic of discourse and has been previously mentioned and activated. After uttering *Plum* the foot shifts to the *R* gradient, and the most-active (or most-primed)

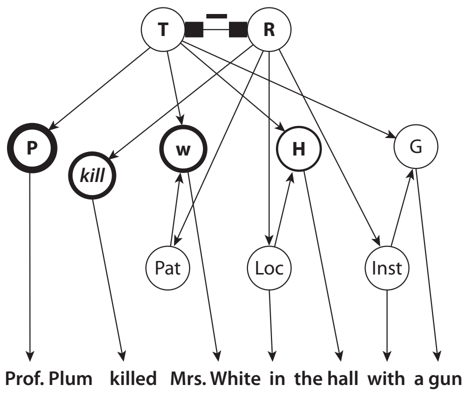

Figure 7. *Topic and relation gradients govern syntax.*

relation, *kill*, dominates competition, is foregrounded, and uttered. *Kill* may further activate selectional and grammatical restrictions, here sketched as *Pat, Loc* and *Inst*.

11. DISCOURSE AND TRANSFORMATIONS. Under the framework of **Figure 7**, consider the following alternative discourses without contrastive stress:

(a) John is a Romeo.
(b) John kissed Mary.
(b') *Mary was kissed by John.

Here *a* activates *John* as the Topic. The preferred continuation *b* then selects the already-activated *John* as the **subject**. Contrast this with

(c) Mary is a Juliet.
(d) *John kissed Mary.
(d') Mary was kissed by John.

In this discourse *Mary* is activated at *c*. The appropriate continuation is *d'* because the topic gradient assigns primacy to the already-active *Mary*. The passive transformation is not at all a transformation of any serial base structure. Nothing moves. Rather, the passive transformation is an adaptive response to the discourse context. In this manner, all major transformations proposed by Chomskyan linguistics can be explained by Adaptive Grammar. Moreover, the explanations, insofar as they depend upon neocortical dynamics (and not upon learning at particular z_{ij}s), are universal across human languages. A few further examples follow.

11.1. DATIVE MOVEMENT.

(e) Col. Mustard met Prof. Plum in the hall.

(f) Col. Mustard gave Prof. Plum a gun.
(f'') *Col. Mustard gave a gun to Prof. Plum.

In this example *Prof. Plum* has been previously activated in discourse at *e*. Therefore *Prof. Plum* has primacy over *gun*. We could say, as many have, that new information comes last, but now we can support such explanations with strong neurobiological evidence.

11.2. ZERO ANAPHORA.

(g) The woman Prof. Plum shot [Ø] died.
(g') The woman Prof. Plum shot the woman died.

In *g*, *the woman* has been uttered and deperseverated, so *g′* would be ungrammatical, and in principle, *g′* would be ungrammatical in any language.

11.3. PRONOMINALIZATION.

(h) The woman whom Prof. Plum shot died.

In *h*, *the woman* has been deperseverated as in, *g*. However, the pronoun *whom* is sufficiently active to be read-out. In general, pronouns are read-out whenever the preceding discourse referent remains deperseverated. English needs no special mechanism to prepose the pronoun *whom*. Because *whom* represents old or given information it reads-out with primacy.

(i) There was a gun in the hall.
(i) Col. Mustard gave it to Prof. Plum.
(i') *Col. Mustard gave Prof. Plum it.

Here *gun* has been given (secondary) topic primacy in the discourse, and in the course of uttering *it* in *g*, *gun* itself was deperseverated, making the proform *it* comparatively active. *It* inherits the topic primacy of *gun*. Only the terminal motor map of *gun* has been deperseverated.

12. CONCLUSION. Many details of Adaptive Grammar remain to be worked out, but the integration of OCOS neocortical dynamics with linguistic behavior unifies many elements of language learning and behavior. Beyond the syntactic dynamics sketched in this paper, one can also begin to see many points of contact with semantics, discourse, and sociolinguistics. For example, Koutsomitopoulou (2004) has applied minimal-anatomy computer simulations to semantic topics like homonymy resolution. Loritz 1999 also extended rebound dynamics to a discourse-based analysis of negation.

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A RELATIONAL NETWORK PERSPECTIVE OF DIACHRONIC LINGUISTICS: A CASE STUDY OF THE FRENCH GENITIVE

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David Lockwood began his 1972 paper on phonological change by saying that 'up to the present, stratificational studies have been confined almost exclusively to synchronic phenomena' (1972:1). Despite the passage of over thirty years, this observation remains mostly true. To my knowledge, only two papers have attempted to outline how diachronic change can be expressed in relational network notation: Lockwood (1972) and Christie (1977).[1] Neither paper tries to account for comprehensive shifts in morphology and syntax, nor do they establish a clear framework regarding the relationship between linguistic change and cognitive processes.

Much of the motivation for writing this paper is a reaction to Brigitte Bauer's *The Emergence and Development of SVO Patterning in French* (1995). Bauer's work is from a generative perspective, but I have adopted those ideas which are compatible with relational network theory. For example, she treats changes in morphology and syntax as partaking of the same diachronic process, and makes this explicit by using the same notation for both.[2] In relational network theory, her treatment corresponds to regarding these two linguistic sub-systems as belonging to the same stratum, for which Reich (1970) has argued for synchronic reasons.

Although I disagree with the foundations of many of Bauer's arguments as well as her conclusions, I will confine myself to showing how the evolution of the genitive can be described in relational network notation. I will then use this specific example to demonstrate what kinds of *valid* connections can be made between historical linguistics and the cognitive and natural sciences. It is this aspect of Bauer's work that is most problematic. Language is a cognitive system, and so it is impossible to regard its evolution without wondering about the cognitive processes that underlie it. However, the inherent differences in the objects of study forces us to view the relationship between language evolution and acquisition as necessarily complex.

1. Issues in the diachronic analysis of French.

1.1. The erosion hypothesis. Traditionally, diachronic linguistic analyses of the French language tended to posit that changes in one linguistic sub-system acted as a catalyst for changes in other sub-systems. Perhaps the most famous such analysis is Vennemann's erosion hypothesis, which claims that the contrasts between case endings were obscured by phonetic erosion and that in turn, this created the need for the emergence of a fixed word order as a marker of grammatical function.[3] Bauer (1995) refutes this analysis using a number of arguments, of which two will be mentioned here.

The first argument involves word order. Bauer argues that Vennemann's explanation 'presupposes an indiscriminately free word order in Latin… [ignoring] the testimonies of the period and the corroborating data which prove that word order in Latin was not as free as it is often claimed to be'. As she explains, Latin had an unmarked order of SOV, and all other possible orders were marked variants, used for either stylistic or syntactic reasons (*ibid*:6). As many linguists have suggested, true synonymy does not exist, and this is certainly true for word order. Thus, as Bauer argues, the notion of marked and unmarked word orders is central to the study of diachronic linguistics.

Bauer contends that a further problem with Vennemann's hypothesis is one which is shared by many traditional explanations of French linguistic change (c.f. Bourciez 1956): the cause of the initial change fails to be accounted for (Bauer 1995:9). Given that inflectional morphology played such an important role, 'it is unclear why the erosion happened at all' (*ibid*:6). While the rest of the changes seem to follow (logically at least) from the first, the effect of such an explanation is to push what cannot easily be explained into the recesses of diachronic linguistic knowledge. Part of Bauer's argument for her thesis is that in order for the inflectional endings to disappear in favour of a fixed word order, this word order must have been already present in the language, thereby making the phonological markings redundant.

2.2. LEFT BRANCHING VS. RIGHT BRANCHING. Bauer purports to resolve the aforementioned issues using a form of generative X-bar theory. Although X-bar theory was originally conceived to represent syntactic structures only, she defines the head in such a way that the definition is valid for morphological structures as well: '…the head assigns a syntactic function to its complement and it indicates, hence expresses, the grammatical value of this element' (Bauer 1995:44). With this definition, Bauer proposes that the emergence of both SVO word order and analytic forms out of their Latin counterparts is more generally described as an evolution from left branching (LB) structures to right branching (RB) structures. **Table 1** depicts both the definition of the head and contrasts LB and RB structures according to Bauer's definition (adapted from Bauer 1995:25).

Bauer attempts to explain the reason for the change in branching by appealing to language acquisition data. She claims, 'it is legitimate to establish a correlation between language change and language acquisition, because in both fields the chronological order of the emergence of structures is essential' (Bauer 1995:16). She claims that RB structures are more easily acquired, and therefore that they present 'an important advantage over left branching' (Bauer 1995:208). Hence, according to Bauer, the underlying motivation for linguistic change can be traced to language acquisition.

2. CRITIQUE OF BAUER'S HYPOTHESIS.

1.1. THEORETICAL CONCERNS AND PSYCHOLINGUISTIC CONTROVERSIES. Bauer's approach to the evolution of French morphosyntax includes some important and useful principles, but is, on the whole, problematic. While it is clear that one of the main differences between Latin and Modern French is that the order of elements has reversed,[4] it is less convincing that branching and the notion of the head in X-bar theory are the appropriate

	Meaning	LB Structures		RB Structures	
		Complement	**Head**	**Head**	**Complement**
Phrases	he led the army	object *exercitum*	verb *duxit*	verb *il conduisit*	object l'armée
	the present of the Gods	genitive *deorum*	noun *munus*	noun *le present*	genitive *des dieux*
Inflectional Forms	bigger	adjective *grand*	degree *-ior*	degree *plus*	adjective *grand*
	with laws	noun *leg*	ending *-ibus*	preposition avec	noun des lois

Table 1. *LB structures in Latin vs. RB structures in Modern French.*

tools to capture this generalization. In his review of Bauer's book, David Lightfoot discusses several problems with Bauer's use of branching and X-bar theory. One such problem is that the order of elements may not be related to branching or head ordering:

> …Latin verbs follow adverbs and PPs [prepositional phrases] even when the adverb or PP is sentential, i.e. not a member of the VP [verb phrase] headed by the verb. Therefore, there is more to be said, and adverb-verb and PP-verb order cannot be invoked as indicating a left branching VP (Lightfoot 1996:157).

Much more controversial than Bauer's generative approach and the tools she uses are the psycholinguistic claims that she makes. The claim that LB structures are more easily acquired than RB structures raises an obvious question: why would LB structures have originated in the first place? Bauer admits that this 'remains to be explained' (1995:217). This is highly unsatisfactory and reveals that she has committed the same error for which she criticizes Vennemann—she proposes an explanation that is unverifiable and, I would argue, untenable. The assumption that language evolves so as to become easier over time raises many controversial issues, and Bauer does not properly address these in her work.

In fact, the data that Bauer presents are insufficient to lay the basis for a psycholinguistic account of language change. She states that 'as long as we deal with noncomplex structures, there are no fundamental differences between left and right branching' (*ibid*:183) and that 'typologically different structures in one and the same language do not have different acquisition rates' (*ibid*:207). Thus it is surprising that she would then conclude that the shift from LB to RB is attributable to language acquisition. Acquisition rates of LB and RB structures differ only in complex structures (e.g. the relative clause) and only *across* languages, not *within* the same language; there is thus no psychological advantage for the Old Latin speaker, for example, to forgo the LB genitive-noun sequence in favour of the RB noun-genitive one.

Not only is it the case that there are no data to support the claim, I will argue that there is, *a priori*, no justification for it. To make such a claim ignores the complexity of language change and the fact that language use is inextricably tied to sociolinguistic factors.

Further, such a view cannot be reconciled with a cognitively realistic perspective of the linguistic system.

2.2. UNREALISTIC FOUNDATIONS. In pursuing her goal to find one underlying cause for language change, Bauer gives too little credit to the influence of pragmatic, stylistic and sociolinguistic factors as *reasons* for language change. The influence of these factors on language change is well known and plays a significant role in Bauer's discussion of marked vs. unmarked variants. In fact, given the central role she assigns to markedness in language change, it is odd that she ignores the *causal* nature of such influences.

Bauer justifies this neglect and the connection she makes between psycholinguistic data and historical linguistic study by referring to the importance of the chronology of the emergence of structures in both fields (*ibid*:16). However, this is fallacious; just because two processes have a certain chronology does not imply some sort of correspondence between the emergent structures.

Language acquisition is a cognitive process, rooted in and ultimately governed by the physiology of the brain. It is unidirectional by necessity. Language change, however, is an evolutionary system. Thus it is not inherently unidirectional. This fundamental difference between language acquisition and language change prohibits the kind of simplistic relationship between the two that Bauer tries to establish. The relationship is necessarily complex. Bauer makes such a simplistic connection precisely because she perceives language change as unidirectional and in this respect, similar to biological evolution. That Bauer does this stems from a misunderstanding of evolutionary systems, and she betrays this misunderstanding when she makes the following claim:

> The comparison with biology in itself is interesting because although the fundamental principles or the driving power are still not understood, the concept of evolution is accepted in biology; hence phylogenetic change is considered unidirectional (1995:16).

This statement is flawed in many ways. First, the fundamental principles of evolution *are* understood (and were in 1995 as well). Second, evolution is not merely accepted in biology—it is its central unifying concept. Finally, not only is phylogenetic change *not* considered unidirectional, but this claim does not follow from the first two points. In making the analogy to phylogenetic change, Bauer is making an appeal to authority, but she does this with little understanding of the field to which she makes the appeal.

3. TOWARDS A COGNITIVELY REALISTIC PERSPECTIVE OF LINGUISTIC CHANGE.

3.1. A CLARIFICATION OF TERMS. Bauer's notion that language changes so as to become more easily acquired is reminiscent of some of the many misconceptions regarding the theory of evolution. There are many ways to misinterpret the statement of the theory, but the misconception relevant here is that evolution is '[a] gradual process in which something changes into a different and usually *more complex* or *better* form' (answers.com/evolution,

emphasis added). Given the prevalence of this interpretation, it seems necessary to recall the correct one:

> In the broadest sense, evolution is merely change, and so is all-pervasive; galaxies, languages, and political systems all evolve. Biological evolution… is change in the properties of populations of organisms that transcend the lifetime of a single individual. The ontogeny of an individual is not considered evolution; individual organisms do not evolve. The changes in populations that are considered evolutionary are those that are inheritable via the genetic material from one generation to the next (Futuyama 1986).

There are two things to note about this interpretation which are important for linguists who wish to draw parallels between language change and evolution. The first is that '*evolution is merely change*': in other words, it is not directed and it is not planned. It does not happen for the benefit of the population and it has no motivation; in particular, this means that it is not unidirectional. Evolution happens as a result of selection pressures, and these are entirely unmotivated. The only 'unidirectionality' that exists in evolution appears as a result of human hindsight, and is not in any way inherent to the evolutionary process.

The second thing to remember is that biological evolution 'transcend[s] the lifetime of a single individual'. *It is not a property of the individual, but rather a property of a set comprised of individuals*. The study of evolution is therefore the study of trends and proportions. This is a distinction that may be blurred in casual speech, but it is imperative that it be maintained in any scientific use of the word 'evolution'.

The comparison that Bauer makes between language change (in which she finds trends of unidirectionality) and evolution (which she thinks is unidirectional), has no basis once the definition and correct interpretation of evolution are understood. Although the analogy that Bauer makes to evolution is fundamentally flawed, this does not imply that there is no such analogy to make. In fact, as the next section shows, the analogy that can be made is quite powerful. It accurately reflects how language changes and moreover, can be reconciled with a cognitively realistic perspective of the linguistic system.

3.2. LINGUISTIC CHANGE AS AN EVOLUTIONARY SYSTEM. In *Pathways of the Brain*, Sydney Lamb discusses linguistic variation and patterning in terms that are highly reminiscent of evolution, but he does not explicitly identify language change as an evolutionary system. Of most relevance to this paper are two principles in linguistic patterning: diversity and survival.

Lamb notes that 'diversity [exists] in linguistic expression… not only among different persons but within the same person' (Lamb 1999:244). This is a readily observable phenomenon. Another way to say this is that a language is continuous in time and space. Despite this continuity, there are patterns found in linguistic expression (in all linguistic subsystems) which show uniformity, not diversity. This is due to survival: 'some variants… are more likely to survive than others; we may say that they have a greater survival value' (*ibid*). Lamb's terminology is clearly reminiscent of biodiversity and what has been

(unfortunately)[5] termed 'survival of the fittest'. But what makes a particular linguistic structure more likely to survive? Lamb answers this question both for the individual and for the linguistic community:

> Survival value can only be explained as a cognitive phenomenon: Surviving means being reinforced in the minds of the people. Reinforcement means strengthening of connections. To understand these phenomena we have to consider not only the cognitive system of the individual—the child learning to use language and the adult learning more—but also the community, consisting of multiple individuals, among whose cognitive systems the different linguistic phenomena keep reverberating. (*ibid*:246)

Lamb's notion of variability and patterning is a direct consequence of a network view of the linguistic system. Furthermore, this perspective implies that a language does not change 'one person at a time', but rather 'one utterance at a time'.

Historical linguists, however, do not study each and every utterance spoken by each and every person in a given linguistic community. Furthermore, to describe linguistic expressions individually over time and space would fail to capture the generalizations of which they are a part. The question remains: how can diachronic linguistic study be reconciled with a cognitive linguistic model?

Fortunately, if we continue to look to the evolutionary biologists for inspiration, we find a solution. Biologists have a shorthand for referring to phylogenetic change, and even to phenotypic properties of species. In describing the evolutionary advantages of certain traits, biologists often say, for example, that an animal is a certain colour *so* it can camouflage. Likewise, it is common to speak about a certain trait in a species changing over time, or through different regions, as though the property of that trait belonged to the *set* of animals as opposed to the individual members of the set. Biologists can use the shorthand because the underlying process is well understood and rigorously defined. Evolution is nothing more than the study of trends and proportions in the population, and this shorthand simply describes the prevalence of one type. The same shorthand can be used with diachronic linguistics, and in fact, this is what descriptive work in historical linguistics has traditionally done. It should be noted that Lamb's account of linguistic diversity is essentially a restatement of the idea of proportion and prevalence. '[I]t is not necessary that a pattern be cognitively useful… for *all* members of a speech community. If it is useful only for a critical mass, that is enough to ensure its survival' (Lamb 1999:247). There is no loss of legitimacy in using shorthand like 'language change' and 'language variability', as long as the underlying process is kept in mind.

Language change in time (the study of diachronic linguistics) and in space (the study of sociolinguistic variation) is the change in proportion and prevalence of certain linguistic structures found in the linguistic systems of individuals. Of course, the parameters of study are arbitrary. We may speak of Latin changing to Old French, thus identifying only two time periods of study, or we may chose a more refined partition of time and look at the changes from Old Latin to Classical Latin, then from Classical Latin to Late Latin, and

so on. If we were to carry this refinement to the extreme, we would study the changes from one generation to the next or even, in a given population, the prevalence of certain structures from one utterance to the next. If, instead of fixing the geographical location, we were to fix our attention to a given time, we would be looking at sociolinguistic variation. Again, since the parameters of study are arbitrary, we could theoretically reach an extreme refinement of linguistic geography and study, as Reich has put it, the 'North Bedroom Dialect' vs. the 'South Bedroom Dialect' (Reich et al. 1977).

This definition of language change is nothing more than a restatement of what is (often tacitly) held to be true among linguists, but when coupled with the idea that the linguistic system is a network of relationships, it has several important consequences regarding the cause and mechanism of linguistic change.

3.3. MECHANISM AND CAUSE OF LINGUISTIC CHANGE. William Christie makes an important distinction between the mechanism and the cause of linguistic change (Christie 1977:59). Common to Christie's and also Lamb's account of the mechanism of linguistic change is that weak or latent connections become strengthened by repeated activation (*ibid*:62, Lamb 1999:244–47). This is a consequence of the network view of language acquisition, both in children and in adults, as was described above, in Lamb's discussion of survival and reinforcement. It turns out that Bauer was not wrong in seeking a connection between diachronic linguistic change and language acquisition; there is a connection, but it lies in the *mechanism* of linguistic change, not in the cause.

Finally, we come to the problem of determining the cause of linguistic change. Actually, we already have our answer. As discussed, the mechanism of linguistic change is the creation of new connections and the strengthening or weakening of existing connections. These changes happen as a result of increased stimuli or, in other words, a gradual increase and continuous exposure to certain conditioning factors. The frequency of occurrence of the conditioning factors is important, as this is one of the properties that confers survival value (Lamb 1999:245). As Lamb (*ibid*:246) explains, 'Frequency of occurrence is determined by frequency of the conditions—social and environmental and linguistic—for occurrence of the meanings/functions which such forms express'. In other words, *the conditioning factors that are required for each and every utterance are, over time, the causes of linguistic change*. Conditioning factors are (for the most part) external to the linguistic system, vary through time and space, and, most importantly, are not inherently directed. There is no one cause or underlying motivation for language change that is inherent to linguistic evolution. Therefore, one of the primary goals of the historical linguist is to determine which conditioning factors, or (in evolutionary terminology) which selection pressures, are effecting change in the linguistic system.

3.4. RELATIONAL NETWORK THEORY AS A MODEL FOR LINGUISTIC CHANGE. Regardless of the notation used, a relational network diagram will always be static in at least one respect. Even Sydney Lamb's dynamic relational network notation, which he uses to account for change in the linguistic system, is static in either time or space. A thick line, representing a strong connection, can be interpreted in one of two ways. If time is held

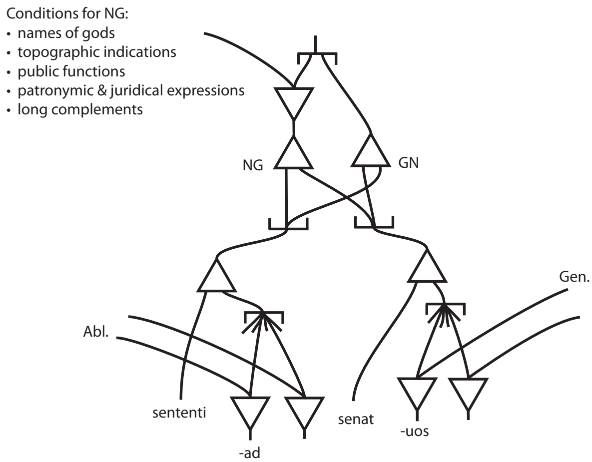

Figure 1. *Old Latin unmarked GN order.*

fixed, then the thickness of the lines represents the relative prevalence of linguistic structures in the community at a given time. In a temporal diagram however, the thickness of lines represents the relative strengths of connections over time, in a given individual.

In the following discussion of the evolution of the genitive from Old Latin to Modern French, I have chosen to use the traditional relational network notation, as a purely descriptive tool[6]. This is a required first step in any diachronic analysis. I will then use Lamb's dynamic relational network model to show that, holding time fixed, we can see the prevalence of the prepositional phrase structure over the absolute construction. Finally, I will show not only that relational network notation is appropriate for the description of diachronic phenomena, but also that it enables us to predict which structures will change.

4. THE GENITIVE. In developing a stratificational approach to language change, Christie (1977:15) explains, 'Unless the whole process is broken up into a number of stages that follow in close succession, it may be difficult to locate the focus of the change'. For some structures, this is difficult, if not impossible, but the history of the genitive is one that is well documented from Old Latin onward.

4.1. LATIN: FROM GN TO NG. In the *Senatus Consultum de Bacchanalibus (SCdB)*, a juridical text from 186 BCE, the genitive precedes the noun it modifies in all but two cases. This is characteristic of Old Latin, in which the order genitive-noun (GN) was unmarked, while the noun-genitive (NG) order was used for specific uses of the genitive: names of gods, topographic indications, long complements, public functions, and patronymic and juridical expressions.

Figure 1 shows a relational network diagram that depicts the unmarked GN order of Old Latin and the conditioning factors that produce the NG order. The phrase in the diagram is an example of a GN ordering (Bauer 1995:53), from the *SCdB*:

Total	GN	NG	Pronominal	GN	NG	Nominal	GN	NG
1250	673	577	233	167	66	1017	506	511
	53.8%	46.2%		71.7%	28.3%		49.8%	50.2%

Table 2. *Distribution of GN & NG in Bennett's corpus (Bauer 1995:56).*

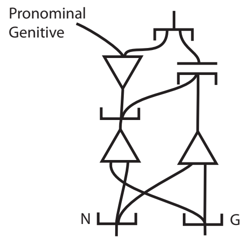

Figure 2. *Early Latin GN vs. NG order.*

(1) senatuos sententiad
senate.GEN. decision.ABL.
'with the decision of the senate'

After the Old Latin period, there is no longer a preference for GN structures, and both GN and NG are prevalent in the writings of the time. At first glance, the statistics do not seem to indicate a clear preference for either ordering. This suggests that a random disjunction node should replace the ordered disjunction and the inverse conjunction leading up to semantics. However, Charles Bennett's analysis of the works of the Early Latin playwrights Plautus and Terence shows that there are in fact grammatical conditioning factors governing the choices of GN and NG (see **Table 2**).

Table 2 shows that in the case of a pronominal genitive, the preferred order is GN, but that there is no preference of either GN or NG in the case of the nominal genitive. Thus, a random disjunction node is still present in the relational network diagram of **Figure 2**. As Bauer notes, it is assumed that a more detailed analysis of the data would show further conditioning factors. (Bauer 1995:56).

By the Classical Latin period, the postposed genitive was unmarked. Cases where the genitive preceded the noun included antithesis and 'sequences with adjective and genitive governed by the same noun' (Bauer 1995:56). Thus the Modern French order of NG was established by the Classical Latin period, as depicted in the relational network diagram of **Figure 3** (overleaf).

4.2. OLD FRENCH: THE PREPOSITIONAL PHRASE. The discussion of the genitive has thus far focussed solely on the ordering of constituents and the transition from GN to NG. The Modern French word order of the genitive noun phrase was already in place by the Classical Latin period, as well as a construction that was optionally available: the use of the preposition *de* with the ablative case. In Old French, the genitive was expressed either by using

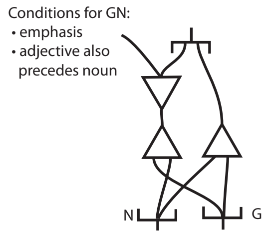

Figure 3. *Unmarked NG order in Classical Latin.*

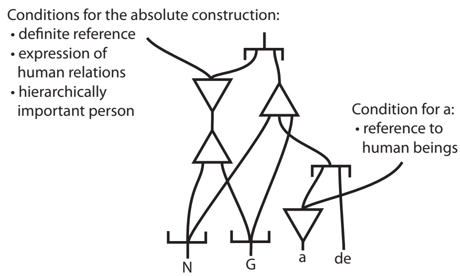

Figure 4. *The genitive in Old French.*

the absolute construction or by using a prepositional phrase; in both cases, the genitive followed the noun and used the oblique case. For example, the relational network diagram in **Figure 4** describes the following absolute construction:

(2) *la fille* *le roi*
the daughter.NOM. the king.OBL.
'the king's daughter'.

Given the specificity of the conditioning factors for the absolute construction, it is not surprising that it gave way to the prepositional phrase. The same is true for the preposition *a*: with only one conditioning factor, it fell into disuse in favour of *de*.

The statements of the above paragraph can be captured explicitly by generalising Lamb's dynamic relational network notation to describe the frequency of occurrence in a community rather than in a specific individual. This is shown in **Figure 5**. This diagram is true for a given moment of time, and the various thicknesses of lines represents how common the different structures are in the linguistic community. I have depicted the prepositional phrase with *a* as having the thinnest line, since it only has one conditioning factor. The absolute construction was relatively common in Old French, but it was only used given certain conditioning factors. Therefore, the unmarked variant, the prepositional phrase with *de* is depicted by the thickest line. For this reason, this is the form that survived.

To show the mechanism of linguistic change in greater detail using the dynamic model, it would be necessary to determine the relative frequencies of the various constructions at

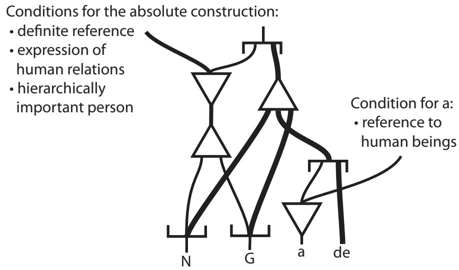

Figure 5. *Dynamic relational network diagram of the OF genitive.*

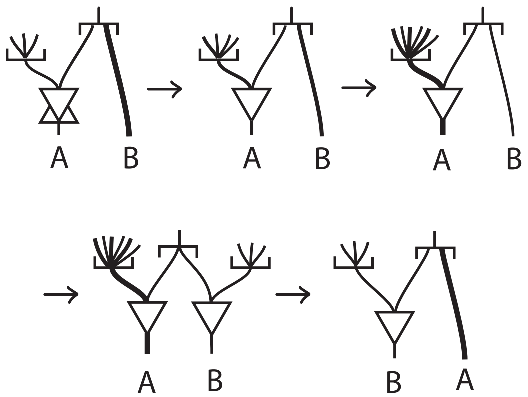

Figure 6. *Chronology of linguistic change using dynamic relational network notation.*

sequential moments in time. By showing the relative proportions of the various structures using varying line thickness, one could construct a sequence of relational network diagrams which together depict the relative frequencies of activation changing over time.

5. THE MECHANISM AND CAUSE OF CHANGE IN RELATIONAL NETWORK THEORY. The change from GN in Old Latin to NG in Classical Latin and the consequent emergence of the prepositional phrase in Old French provides an opportunity to observe linguistic change in relational network notation.

Figure 6 depicts a simplified chronology of linguistic change, with five stages. In Stage 1, the unmarked order is B. If, over time, the conditions which generate A become either more frequent (as shown by the thicker lines feeding into the inverse disjunction node) or more numerous, then the relative prominence of B will decrease. If this trend continues, in which the conditioning factors for A increase in number and/or frequency, then there will be a point at which B requires conditioning factors as well; this is depicted in Stage 4. This stage may *appear* to be randomly distributed between A and B in the data. However, it must be stressed that even if two structures appear to be synonymous, there will always exist a difference between the two, whether semantic, pragmatic or stylistic. If the conditioning

factors for A become frequent and numerous enough that B is only selected occasionally (and only in certain circumstances) then A becomes the unmarked variant, as shown in Stage 5. If the factors leading to B become obsolete, then we cease to have any sort of disjunction at all, and we are left with direct realization.[7] This is the case in Modern French, in which the nominal possessive is signalled by the preposition *de* and the NG order. Of course, fixed expressions such as *Dieu merci*, which feature the absolute construction of Old French, are no longer governed by either syntax or morphology.

Figure 6 is an example of how relational network diagrams are able to capture linguistic change. By using the dynamic relational network notation to depict the relative frequencies of different structures in a linguistic community, we are able to see the effect of the conditioning factors on the language, and how they act as selection pressures over time.

One of the advantages of using relational networks to describe linguistic change is that they explicitly show the same pattern of change happening in different places. The notion of marked and unmarked structures has proven to be crucial to an understanding of language change. Using relational network notation, we can isolate certain patterns of nodes as likely to change, by examining how the frequencies of the various conditioning factors are changing. Further studies may show that there is a given threshold at which A ceases to be the marked variant; in other words, a threshold at which conditioning factors for A are no longer needed to send a successful signal down.

6. ISSUES IN FURTHER RESEARCH. As I have argued above, if linguistic change is to be regarded as an evolutionary system, then there is no unidirectionality in linguistic evolution. However, to say this ignores the fact that trends of unidirectionality are perceived and described by historical linguists. It is therefore important to outline in what ways these descriptions are compatible with a theory of linguistic evolution.

Lamb argues that correlations in linguistic structures result from the fact that '*cognitive systems automatically support similarity*' (1999:247, emphasis in original). If directedness in linguistic change is a special case of patterning, then unidirectionality is not mysterious, but rather follows directly from a natural cognitive process.

An example of this is in the Modern French verb conjugation system. The simple past, *passé simple*, is a literary tense, but it expresses the same meaning as the composed past, *passé composé*, though they used to differ in meaning. There are two verb tenses to express the future in French: the simple future, *futur simple*, and the 'close future', *futur proche*. Second language learners of French are taught that there is a difference between the two tenses, and that the *futur proche* is used for the immediate future.

This is no longer the case in France. The *futur proche* is used almost exclusively for both simple and immediate future events. In terms of meaning, the two tenses have become synonymous. But they are not in free variation. The *futur simple* is considered to be more formal, and is thus used primarily as a literary tense among younger French speakers. Bauer mentions this case and says that it is a modern case in which left branching structures, e.g. the *futur simple*, are being abandoned in favour of right branching ones, e.g. the *futur proche* (1995:85). There exists an alternative analysis to Bauer's. The *passé simple* and the

	Synthetic	**Analytic**
Past	Passé simple: je chantai	Passé composé: j'ai chanté
Future	Futur simple: je chanterai	Futur proche: je vais chanter

Table 3. *Synthetic vs. analytic verb forms of the French verb* chanter *'sing'.*

futur simple are both synthetic tenses, whereas the *passé composé* and the *futur proche* are both analytic tenses, formed with an auxiliary and fixed ending (see **Table 3**).

The key conditioning factor to produce the synthetic *passé simple* is that one is writing a text of a certain level of formality. It is rarely encountered outside of a literary setting, and when it is, it is employed in distinctly formal situations. By analogy then, young French speakers are likening the synthetic *futur simple* with the *passé simple*, and using it primarily for writing and other more formal situations. It is not the direction of branching that is at issue here, but rather the fact that, *given* the special conditioning factors for the *passé simple* and *given* its likeness in structure to the *futur simple*, speakers are imposing the special conditioning factors of the *passé simple* to its future counterpart.

The notion of unidirectionality as a description of diachronic linguistic phenomena is not at odds with linguistic evolutionary theory, but it cannot be considered inherent to the evolutionary process, nor is it cognitively realistic to assume that a language changes to become easier, better, more complex, or to achieve any goal whatsoever. Nevertheless, when change occurs, it is often the case that related parts of the linguistic system will also change in a similar way.

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1 Lamb (1999) discusses dynamic relational network theory to account for change in the linguistic network, but does this primarily to account for change in the individual. Though he does mention linguistic change in the community, he does not detail how this can be reconciled with diachronic linguistics.

2 Although the claim that morphology and syntax occupy the same linguistic stratum requires argumentation, it is beyond the scope of this paper to do so. It is a valid assumption for my purposes, as I am concerned with the emergence of syntactic case markings out of morphological ones as a single, diachronic linguistic process.

3 It should be noted that Vennemann does not proffer a cause and effect proof; nevertheless, the proposed sequence of events carries with it many implications.

4 Bauer (1995:10) admits that this observation precedes her work, but notes that it was confined to morphological structures.

5 I say 'unfortunately' because this catch phrase, has contributed greatly to misunderstanding of the theory. The root of the problem seems to be an equivocation of the word 'fittest'. A particular animal is 'fit' for survival in a given environment, not in any absolute terms. Many people have misinterpreted this phrase to mean that organisms are becoming more fit, and that they are evolving away from a 'less fit', more primitive form.

6 Since the study of language change is based on trends, proportions and statistical measures, another notational possibility is Earl Herrick's probabilistic network notation, as developed in

his *Sociolinguistic Variation: A Formal Model.* I will not make use of Herrick's notation in the present paper since it is not my purpose to do a detailed analysis of the statistical data available. However, his goals and motivation for developing this notation are complementary to the notion of linguistic evolution that I have developed in this paper: '[to] describe how alternations inside language are conditioned by environments located outside language, and… [to describe] probabilistic alternations' (1984:1).

7 This figure (with minor modification) can also account for language acquisition phenomena, such as the use of *goed* after the child uses *went*. Stage 3 depicts the linguistic network of a child who uses went (B), but is learning that most forms of the past tense end in *-ed*. After briefly passing through Stage 4, the child skips Stage 5, going straight to direct realization (not shown in **Figure 6**). Only later does the child adjust for this hypercorrection and returns to Stage 5 (Reich, personal communication).

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LANGUAGE DATABASES, STATISTICS AND SOCIAL NETWORKS

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PERSONS WHO DO NOT SPEAK THE SAME NATIVE LANGUAGE are experiencing linguistic frustrations during one-on-one encounters more and more frequently. Here are a few linguistic frustrations experienced by friends of the authors during a recent trip to China:

1. They were looking for Tiananmen Square, but the Chinese locals couldn't understand their pronunciation of Tiananmen Square.
2. The husband wanted to receive a discount admission because of his age. However, he did not look over 65 to the person selling tickets, and he failed to communicate with her.
3. The couple wanted typical American-style vanilla ice cream, but the Chinese servers brought purple ice cream and did not understand the reference to white ice cream.
4. The husband caught a bad cold but was unable to describe his symptoms to a pharmacist. Pantomime was only of limited usefulness.
5. They ran out of cash and tried unsuccessfully to explain to a bank teller their need for credit card cash advance. Finally, they called their son in the United States, who wired them some money.

These encounters, which we will call *micro global events*, can be carried out through such modalities as a telephone conversation, an e-mail exchange, an instant messaging session, or a face-to-face contact.

A *global* event is a gathering of many people, often involving a number of native languages, from around the world either through telecommunications (Women's Day 2005) or through a literal gathering, such as a major sporting event (FAQ Farm 2005). A *micro* global event, in contrast, involves just two people and two native languages. Myriad communication difficulties occur every day around the world during micro global events. Consider the fact that over 26 million people visited Paris in the year 2000 (*France Monthly* 2005), the vast majority of whom did not speak French.

Many linguistic frustrations can be resolved by having instant access to relevant multilingual information.

We wish to consider how to facilitate communication, in a cost-effective way, during micro global events. Existing resources are not necessarily cost effective or readily available. The well-heeled traveler can hire an escort interpreter for a mere $200 to $300 per day, plus expenses. (Beatriz Bonnet, personal communication). If interpreting services are only needed occasionally, the business person with an expense account who needs to

communicate across a language barrier by telephone with a colleague can use a telephone interpreting service that involves a three way call with a professional human interpreter for about $2 per minute (Don Halliburton, personal communication). In an emergency, such as illness or legal difficulties, there may be free community interpreting services, but most micro global events do not qualify for these services.

We will now turn to a quite different approach to dealing with linguistic frustrations: building a large computerized language database that people all over the world can contribute to and use anytime through a mobile phone or other handheld device. After setting out some basic requirements and considering the role of statistics in evaluating and justifying its content, this paper will largely focus on which abstract model to use for the database: a lexicographical or terminological model.

DESIGN REQUIREMENTS. Some basic design requirements that have been established for this language database are the following:

1. Multi-word language units: The database must store information not just about words but also phrases, and even sentences.
2. Multidirectional multilinguality: The database must be multilingual, allowing entries to start with any language in the database and link to any other language.
3. Additions and updates: Database response must be fast, and it must be convenient to propose a new entry or an update to an existing entry from a Web browser.
4. Accessibility: The database must be accessible from personal computers and through advanced mobile devices.
5. Integration: It must be possible to integrate the database with other applications, such as e-mail, instant messaging, and web browsing.

The basic financial requirement of the database is that it must be free, or in other words, accessible without paying fees other than those required for Internet access or transmission of text or multimedia messages.

An immediate consequence of the five design requirements and the financial requirement is that the database must be developed by a volunteer social network consisting of (a) software engineers, (b) translators and other language experts, (c) sponsors to provide hardware and other basic facilities for the project, (d) various participants in micro global events who report their linguistic frustrations, and (e) native speakers of a variety of languages who propose solutions to linguistic frustrations.

If the language database is to be useful in resolving linguistic frustrations, it must be accessible at the moment of frustration. Thus, it must be available on line while someone is writing an e-mail to a friend or while a concierge at a computer-equipped desk is helping a hotel guest. It must also be available through a mobile data link of some kind during a face-to-face encounter.

Ideally, the information related to words, phrases, and sentences will offer multimedia resources, including images of objects and events as well as sound clips recorded by native speakers.

LTAC. A project to develop such a language database has been initiated by LTAC, a non-profit consortium of language-related organizations (LTAC 2005). The language database described here is a public service project of LTAC implemented on a voluntary basis by LTAC member organizations.

A possible model for the development of the LTAC database is the Wikimedia Foundation's process. The goal of the Wikimedia Foundation is 'encouraging the growth, development and distribution of free, multilingual content' (Wikimedia Foundation 2005). Community developed projects, many of them based on *wiki* software for collaborative authoring, have grown in popularity and volume of input from around the world. They have progressed from no entries to over 22 million entries in 200 languages in approximately five years (*The Guardian* 2005).

STATISTICS. Just as linguistic research now trends away from made up examples and toward corpus studies, the trend in dictionaries and terminology databases is toward corpus-justified decisions and real-life examples. Statistical methods are basic to the LTAC database. Perhaps the most basic application of statistical principles to the project is that new entries in the database, beyond a few infrastructure areas such as numbers, must be justified by actual linguistic frustrations either observed in written communication through corpus analysis or reported first hand by those who experience them. Additional statistical aspects of the LTAC database include counts of how often various items of information in the database are accessed by users and statistical methods for deciding between competing translations of a word, phrase, or sentence, used in conjunction with standard documentation procedures when authoritative bibliographic references are available.

DATA MODEL. Within the preceding framework, there is an important issue that needs to be addressed: the choice of an abstract data model for the language database. There are two well-established approaches that could be used in setting up the data model: a lexicographical approach and a terminological approach. The rest of the body of this paper will distinguish between these two approaches, both of which have many supporters. The discussion will devise a methodology for choosing between the two approaches based on the five requirements for the language database and will apply that methodology to make a decision.

The choice of an abstract data model for the LTAC database will influence its success or failure. Indeed, a data model provides a framework that strongly influences what can be said and done within systems built on the foundation of that data model. As one computer consultant has claimed, 'Without a carefully constructed data model, any system is doomed to failure' (Dorsey 2005).

1. LEXICOGRAPHICAL APPROACH. The lexicographical approach has a very long tradition behind it. It is the approach used in nearly every general-purpose dictionary of English. A lexicographical dictionary entry begins with a headword and continues with some information about the headword, such as its pronunciation and its etymology, followed by a list of word senses, often grouped by grammatical category.

The main characteristics of a lexicographical entry (Wright & Budin 1997:328) are that it:

1. treats a headword
2. treats the various polysemic senses of a headword based on one etymological derivation
3. treats homographs (same letters, different etymology) in separate entries
4. provides all grammatical information pertaining to a word
5. is arranged in strict alphabetical order by headword
6. is usually descriptive rather than prescriptive
7. usually treats words as one large set taken from general usage.

Not all lexicographical resources exhibit all seven characteristics, but the lexicographical approach in general is time-tested and widely used.

2. TERMINOLOGICAL APPROACH. The terminological approach, begun in the early 1900s, is typically not used for general-purpose dictionaries. A terminological entry begins with a concept in a domain and continues with the terms that designate that concept.

The main characteristics of a terminological entry (ibid:328) are that it:

1. treats a concept and is often identified by a non-mnemonic identifier rather than any one term;
2. documents all the terms, often in multiple languages, that are assigned to one concept;
3. treats the various polysemic senses of a term in separate entries;
4. cites grammatical information on a limited basis;
5. is often arranged according to a systematic concept structure, with alphabetical cross-listing of terms;
6. frequently documents preferred or recommended usage; and
7. is restricted to a particular domain.

The field of terminology has evolved considerably over the past few decades as computers have become more widely available and made it more feasible to have multiple, detailed indexes to the same set of concept entries. It is important to note that the terminological approach does not include the assumption that concepts exist in some absolute fashion. It allows for notes about language-specific and region-specific variations of a concept.

3. METHODOLOGY. Viewed in terms of sheer numbers of language reference books on the shelves of a typical bookstore, there are many more resources that use a lexicographical approach than a terminological approach. Indeed, most language learners know about dictionaries and expect them to be organized lexicographically, that is, in alphabetical order according to headword with all the information about the headword appearing in an entry immediately under that headword. However, we will not dismiss the terminological approach on the basis of popularity with the public. Instead, we propose the following methodology for deciding which approach to use in organizing our language database: we will examine the five design requirements for our system that are listed in the introduction

and decide whether each requirement would be better met by a lexicographical or a terminological approach. If one approach is clearly preferable according to a given requirement, we will give that approach one point. If neither approach is clearly preferable according to that requirement, neither approach will receive a point. Then we can simply compare the total points received by each approach, out of a possible five points. If one approach receives more points than the other, then the result will be that we will select that approach.

Of course, this methodology assumes that all five design requirements have equal weight. They may not all deserve identical weighting, but they are all essential and no requirement is clearly at least twice as important as another so we will weight them equally in our analysis and stipulate that for a data model to be declared a clear winner, it must receive at least two points more than its competitor.

4. ANALYSIS. We will now compare the two approaches on each of the five design requirements.

4.1. MULTIWORD LANGUAGE UNITS. The lexicographical approach is focused on headwords and the terminological approach is focused on concepts represented by one or more terms. Headwords are typically one word but can be compounds made up of two or more words, as can be seen in almost any general dictionary. Terms can be one or more words and technical terms often consist of two or more words. A sentence typically does not appear as either a headword or a term; however, sample sentences can appear in dictionaries for language learners, for some headwords in a dictionary, and sentences often appear in terminological databases—termbases for short—as contextual examples. According to ISO 12620, which deals with data categories for computer applications in terminology, context is 'a text or part of a text in which a term occurs' (ISO 1999). Phrases are not typical in either dictionaries as headwords or termbases as terms, but they appear in phrasebooks. A phrasebook is a collection of phrases that are common in the language that is spoken within a country or region. Typically entries in a phrasebook include a pronunciation and an example sentence of how the phrase is used. Phrasebooks can be organized lexicographically, that is, as a dictionary-like alphabetical list of words, phrases, and sentences, or terminologically by grouping phrases according to topics, such as ordering food at a restaurant or purchasing a train ticket.

Neither dictionaries nor termbases focus on all three types of language units (words, phrases, and sentences) and as a result neither data model will be awarded a point relative to the first design requirement. However, it will be necessary to allow for phrases and sentences within the data model that is selected.

4.2. MULTIDIRECTIONAL MULTILINGUALITY. Most dictionaries only contain one or two languages and they are organized using the lexicographical methodology, which means that entries are alphabetized according to their headword with multiple translations under each headword. This may not seem like a problem; however, anyone that has ever traveled abroad and tried to use a dictionary while traveling understands the frustrations that can occur with this type of organization. For example, the Oxford English Dictionary and the

British National Corpus provide the English word *knob* with several word senses which include the following (OED and VIEW 2005):

1. the handle of a door, drawer or cane
2. a knoll or small hill
3. a lump of sugar, coal, butter etc.

Searching for *knob* in a French-English and Spanish-English dictionary provides several translations including:

1. word sense 1
    a. French: bouton, pommeau
    b. Spanish: tirador
2. word sense 2
    a. French: tertre
3. word sense 3
    a. French: noix, noisette
    b. Spanish : terrón

So far we have constructed one entry in a seemingly voluminous but straightforward multilingual English to French, English to Spanish and English dictionary. However, difficulties arise if one attempts to construct multidirectional lexicographical entries from the above entry:

1. The French *bouton* corresponds to the English word *knob* but also to *button* [clothing fastener], *switch* [light switch], and *pimple* [skin blemish].
2. The French *pommeau* corresponds to English *knob* but also to *pommel* [part of a saddle].
3. The Spanish *tirador* corresponds to *knob* but also to *marksman*, *shot*, *shooter* or *button*.
4. The French *tertre* corresponds to *knoll* but also *mound*.
5. The French *noix* corresponds to *knob* but also to *walnut*.
6. The French *noisette* corresponds to *knob* but also to *hazel nut*.
7. The Spanish *terrón* corresponds to *lump* but also *clod*, *clump*, *sod* or *land*.

An integrated multilingual, multidirectional dictionary in which each entry is governed by a headword, not a word sense, and in which all links are from entry to entry, not sense to sense, is incapable of preventing a dictionary user from starting with an English word and finding a Spanish pseudo-equivalent by passing through another language.

To be specific, the presentation of possible headword-based equivalents in the different languages without direct reference to conceptual sense is inclined to lead the user to equate the English word *walnut* to the Spanish word *tirador*, a pair that obviously has no overlapping meaning, but that would seem plausible out of context by following

the equivalence chain: *walnut–noix–knob–tirador.* This problem might conceivably be avoided by using a number of independent bilingual dictionaries, but as we will see, a single terminological entry that provides a concept description together with the multilingual terminological equivalents assigned to that concept will allow an efficient, integrated, multilingual, multidirectional database.

In such a terminological approach entries are organized according to concepts rather than headwords, and each concept is part of a domain.

By placing each concept within a domain and linking concept entries, not headword entries, the same information shown above in dictionary entries could be expressed without allowing linkage errors such as *walnut–tirador*. The link between *noix* and *knob* would be blocked since the 'nut' and 'knob' senses of *noix* would appear in separate concept entries. Therefore a point is awarded to the terminological approach relative to multidirectional multilinguality.

4.3. ADDITIONS AND UPDATES. Adding a new entry or updating a current entry in both a lexicographical and terminological approach can be very simple. However, the lexicographical approach presents some problems for the contributor during the submission of a word sense for an existing entry. First, the contributor must decide if the word sense has the same etymology as the existing entry. Yet, the typical contributor may not be familiar with word etymology and therefore they will not be able to easily make their contribution. In addition, the lexicographical approach also requires contributors to decide whether or not their suggested word sense exists already in the entry. On the surface this may appear to be a trivial problem; however, without a specific domain being designated for each word sense the contributor must decide whether the submission is a brand new word sense or merely a slight deviation from an existing word sense. On the other hand, by approaching the database from a terminological aspect all concepts can be linked into a hierarchy of subject fields or domains. This domain hierarchy helps to specify exactly what the new word sense or concept is related to.

Although the contribution process for both methodologies is similar, the terminological methodology provides a higher degree of precision by positioning concepts within a subject field hierarchy, thus reducing the potential for confusion. As a consequence, another point is awarded to the terminological approach.

4.4. ACCESSIBILITY. If a user is in a specific situation and a linguistic frustration is occurring, a multilingual database could be consulted. If the database uses a strictly lexicographical approach, the user will get all of the possible translations of a term, regardless of domain. Then the user must sift through all translations and decide which translation applies to the existing frustration. However, as previously stated, a terminological approach organizes concepts into a domain hierarchy, which allows users to refine their results to a specific situation. Searches can be conducted by domain or by term within a particular domain. By allowing users to refine the results according to their situation, the resulting data set will be smaller and more exact. This provides a much more accurate and immediate method of searching for the data desired.

Because the terminological approach greatly enhances the speed and accuracy of a query, the point is awarded to the terminological approach.

4.5. INTEGRATION. A multilingual database can only be useful when the data can be accessed via numerous conduits. In today's technology world, SOAP is an exchange protocol that allows applications running on different computers with different operating systems to exchange data via a query and response system (SOAP 2003). This type of protocol is easily adaptable to either the lexicographical or the terminological methodology; however, a question is raised about how the response to a query is returned. When a response is sent to another application or device, it needs to be in a format which is decipherable by the querying application. Developers of the database could create a proprietary format; however, by doing so they force everyone to learn a new format, which could discourage further outside development. On the other hand, using a standard format provides developers with an existing format that can be used with other applications as well. Partly because of the wide variations that exist in the formats used by lexicographical resources, there is not yet an established standard for lexicographical data exchange. In contrast, the overall data structure used in terminological resources tends to be much more uniform, and a standard has already been created for use with terminological data. That standard is called TermBase eXchange or TBX and it is an XML format (LISA-OSCAR 2005). By using SOAP and TBX, the LTAC database could be accessed by email software, instant messaging software and cell phones.

Because there is already an existing standard for representing terminological data, the point for integration is awarded to the terminological approach.

4.6. COMPARISON RESULTS. The final results of the comparison across the five previously mentioned requirements show that the best approach to a multilingual database is the terminological approach, with a total of four points vs. zero points for the lexicographical approach.

5. CONCLUSION. Based on the result of the above analysis, the LTAC database should be organized terminologically. In fact, LTAC has already developed a prototype of such a database as part of a project called GEvTerm (global event terminology). This prototype can be accessed at www.ltacglobal.org/gevterm or more directly at gevterm.org. See the appendix for technical information about the software itself.

We invite the reader to contribute to GEvTerm in three ways: (a) stimulate the creation of new concept entries by reporting actual linguistic frustrations on line and encouraging others to do so as well; (b) update existing concept entries in GEvTerm by adding terms in other languages and (c) make suggestions for improvements to the user interface, search functions, and other aspects of the GEvTerm system. As of this writing, only Olympic sporting events are in GEvTerm. With sufficient effort by a world-wide social network of volunteers, GEvTerm will eventually become a highly useful tool for reducing linguistic frustrations and for conducting statistically validated linguistic studies of writing and speech involving two parties who do not share the same native language. Eventual benefits

could extend to language training materials development focused on listening and speaking skills.

6. FUTURE WORK. The LTAC termbase software being used to develop GEvTerm is open source and may well be useful in other contexts. The GEvTerm project has already been approached by Avaya (a telecommunications company formerly part of Lucent, which was formerly Bell Labs) concerning the possibility of adapting the software for the development of a telecommunications termbase incorporating employee suggestions and data mining techniques (Avaya 2005). Extending the LTAC termbase approach to a general-purpose multilingual language database would involve additional challenges, such as the fact that there is no universally accepted hierarchy of domains that organizes all of human knowledge top down. However, some existing knowledge organization systems, such as UDC (*http://www.udcc.org/about.htm*) are already used in several large termbases and could be used in conjunction with narrow domain names.

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APPENDIX A: SOFTWARE DEVELOPMENT

The GEvTerm site has been designed and developed using several technologies including PostgreSQL, PHP, and XML. The database design could easily be adapted to any other relational database by someone with adequate knowledge. SOAP is an XML protocol that facilitates the exchange of information between applications over the Web. TBX is an XML format for terminological data that can be used in conjunction with SOAP. All of these technologies are open technologies that are freely available. By using open technologies, the project allows other groups and development communities to adapt the design and concepts to their own terminological databases (termbases).

The abstract data model used for GEvTerm is taken from TMF, which is ISO standard 16642. **Figure 1** provides a simplified representation of the formal data model in TMF:

The diagram shows that a termbase (called a Terminological Data Collection in TMF), consists of global information (GI, i.e., meta-metadata) about the termbase, such as who maintains it and who can use it under what conditions, complementary information (CI), such as a set of full bibliographic references that can be referenced from entries and a hierarchy of domains that entries can be linked to, and a set of terminological concept entries. Each entry (a TE), documents one concept and consists of one or more language sections (LS) (potentially hundreds in GEvTerm and other multilingual termbases), and each language section consists of one or more term sections (TS). Each term section contains a term in the object language of the language section that designates the concept of the concept entry. A term section can also include information about a term, such as a sentence using the term and pronunciations pre-recorded by native speakers. Links are made between concept entries and from concept entries to complementary information. The term component section (TCS) provides an optional refinement that can be used to document information such as gender, inflectional form, etc., associated with the individual words making up multiword terms.

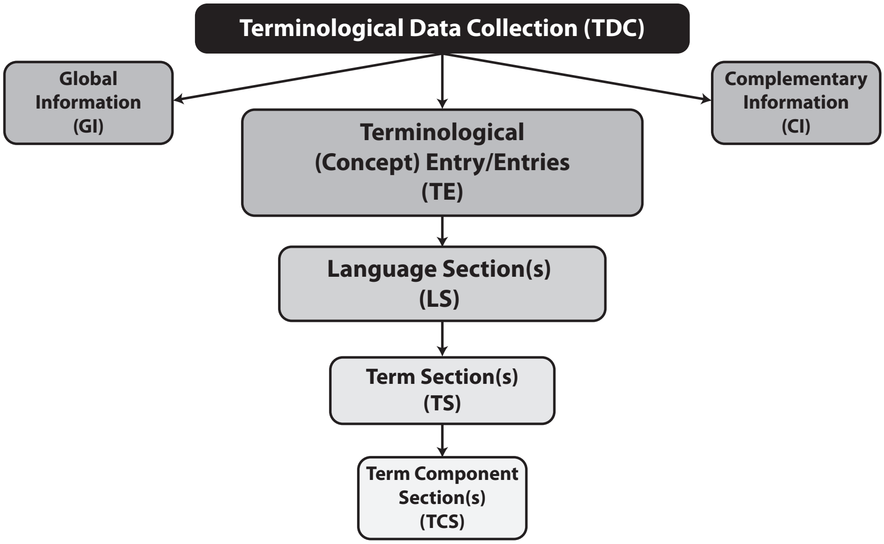

Figure 1. *TMF data model.*

STUDIES OF LANGUAGE IMPAIRMENT: PINKER'S CLAIMS FOR MODULARITY

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THE SUBJECT OF INNATE KNOWLEDGE and linguistic modularity is one that has been debated for many years and has been revitalized since Chomsky's controversial presentation of his nativist approach regarding language acquisition (1955, 1957, 1980). The controversy has been compounded by the detailed description provided by Fodor (1983) of the mind as a system partially composed of modules (or encapsulated sub-systems) working independently to carry out a specific task. Fodor's module is domain-specific and hard-wired, resistant to other aspects of cognition and reliant on data provided by sensory transducers. The modules are uninfluenced by other modules or by more holistic, non-modular aspects of mind.

Pinker, also an important name in the current discussion of what minds are and how they work, describes the mind as being modular, emphasizing the existence of a module dedicated to language which is biologically encapsulated from the rest of our brains and is 'distinct from more general abilities to process information' (1994:18). Although he disagrees with Fodor in regard to *how* modularized the mind is, both agree that language is modular and functionally separate from overall cognition.

Several arguments have been put forward both for and against the thesis of modularity of different aspects of the mind, with varying degrees of agreement emerging. For example, it is generally accepted that vision is made up of several modular processes (Marr 1982), whereas Theory of Mind, the ability to recognize the mental status of others, as a modular process (Scholl & Leslie 1999) is still highly debatable.

Pinker (1994) presents a variety of arguments supporting the existence of a language module, one of the more interesting ones being based on clinical linguistics. Pinker claims that language and cognition are separate mental entities, each of which can be damaged in the brain without affecting the other. This article examines his argument in detail and evaluates the evidence provided in order to ask to what degree it supports the modularity thesis.

The argument for the separation of a putative language module from the rest of our cognitive skills directly opposes the Sapir-Whorf hypothesis which holds language and cognition to be intertwined to the extent that our language makes many aspects of cognition possible and determines our view of the world (1956). Pinker admits that language allows us to have what he calls *inner speech* which enhances thought, but insists that this inner speech is a simply by-product of language, thereby implying its relative expendability in the development of cognition (Pinker & Jackendoff 2005).

Pinker attempts to prove the existence of a language module in the brain by several means, including the presentation of evidence attributed to two groups of diagnosed

patients, one of which he claims has strong linguistic but weak cognitive skills while the other has weak linguistic but strong cognitive skills. He claims that this proves the thesis of modularity through double dissociation.

A double dissociation is a phenomenon sought after in brain research to provide evidence of independent brain processes. By definition, if an individual or group can successfully carry out task A but not task B, while another individual or group is able to carry out task B but not task A, then these two tasks are said to be doubly dissociated, meaning that they are likely to be two separate tasks, neither dependent upon the other. A single dissociation is not sufficient to show neural specificity, because it is possible that a case exists where task B is dependent upon task A, but where the system underlying task A is impaired, but still strong enough to support task B. In this case, task B could still be performed normally, despite its dependence upon the system underlying task A.

Pinker claims a double dissociation to exist between language and cognition in two specific groups of people with different diagnoses, one being Specific Language Impairment (SLI) and the other being Williams Syndrome (WS).

Specific Language Impairment is a diagnosis given to children impaired in the development of language skills. Symptoms may reside in the area of production or comprehension of any combination of semantics, syntax, phonology or pragmatics.[1] The basis of an SLI diagnosis is one of exclusion, in which the child must not display any impairment in non-linguistic intelligence or have any other known reason that could contribute to weak language development such as hearing impairment or marked social or psychological problems (Leonard 1998).

Williams Syndrome is a disorder caused by missing genetic information on chromosome 7. Symptoms include developmental delays, physical disability and severe learning disabilities as well as 'pixie-like' facial characteristics and an extremely affectionate nature. However, there are studies which have indicated that the language skills (and musical skills in some cases) of these children are relatively advanced when compared to their low cognitive profile (Bellugi *et al.* 2000, Jackendoff 1994:117).

Pinker takes the differences reported between children with SLI and those with Williams Syndrome as providing evidence of a double dissociation between language and cognition due to the allegedly opposite cognitive and linguistic profiles attributed to them.

The question under exploration in this paper is whether Pinker's conclusion regarding the double dissociation between SLI and WS is accurate. I scrutinize his conclusion by highlighting some possible weaknesses of the his argument.

1. PROBLEM NUMBER ONE: THE DEFINITION OF DOUBLE DISSOCIATION. Double dissociation was defined earlier as based on the existence of one capacity with the absence of another. In this example, the two postulated capacities are language and non-linguistic cognition. Neither in the case of SLI nor WS do we have a total absence of an ability to perform a task, because both groups retain a certain level of both cognitive and linguistic capacities. However, pure double dissociations are very rare and several studies have relied upon less than perfect examples where capacities are diminished as opposed to eradicated (McMullen *et al.* 2000, Felician *et al.* 2003), so considering this as a fatal flaw of the argument

would be too harsh a judgement. It is worth noting, nonetheless, that a dissociation built on a weakening of capacity for a task is less telling than one based on total absence.

2. PROBLEM NUMBER TWO: NOT ALL WS CHILDREN HAVE LOW IQS. Pinker states that WS children have IQs of about 60. Although this may be an average, some WS children have IQs as low as 20 whereas others are over the 100 mark. Geneclinics website reports mental retardation to be present in approximately 75% of those diagnosed with WS (Morris 1999). Whereas SLI children are guaranteed to have average or above average IQs, due to the very definition of the impairment, Williams Syndrome is diagnosed genetically and a wide variety of cognitive abilities exists within the group. This fact complicates the idea of a double dissociation based on the WS group having low IQs.

Furthermore, children suspected of having language disabilities are often given non-verbal tests to measure their IQ, as opposed to regular IQ tests which measure both verbal and non-verbal IQ. This is done so that a linguistic weakness does not hinder the measurement. Non-verbal IQ tests are heavily dependent upon visuo-spatial tasks such as block arrangement and pattern formation (Elliott 1996, Wechsler 2003). Research (Greer *et al.* 1997, Mervis *et al.* 1998) has shown systematically that children suffering from WS have distinct problems with visuo-spatial skills. They therefore tend to score poorly on non-verbal IQ tests which rely on visuo-spatial measures, leading to the question of whether it is possible to measure the cognitive skills of these children accurately with this type of test.

3. PROBLEM NUMBER THREE: IT MAY NOT BE TRUE THAT WS CHILDREN HAVE NORMAL LANGUAGE. The jury is still out regarding whether children with Williams Syndrome are linguistically impaired. Although some studies have supported the claim that these children are linguistically gifted (Bellugi *et al.* 2000, Jackendoff 1994:117), other researchers claim the opposite (Karmiloff-Smith *et al.* 1997, Laws & Bishop 2004) or find that those with strong verbal skills represent a minority of cases which tend to bring up the mean in group studies (Jarrold et al 1998). One recent and comprehensive study (Stojanovik et al 2004) set out specifically to look at the language of a group of WS children in comparison to a group of children diagnosed with SLI. An identical extensive battery of non-linguistic psychometric tests as well as language-based tests were given to each group with the specific aim of testing whether a double dissociation exists. A wide variety of skills were tested including:

Language-based skills

Receptive vocabulary	British Picture Vocabulary Scale
Receptive grammar	Test for the Reception of Grammar
Expressive language	Clinical Evaluation of Language Fundamentals

3 subtests:

- Formulation of complex and compound sentences
- Recall and reproduction of sentences
- Assembling grammatically and semantically correct sentences

Non-verbal cognitive skills
Wechsler Intelligence Scale for Children
Subtests:
Picture completion (which part of the object is missing)
Picture arrangement (putting pictures in order to tell a story)
Block design (reproducing patterns with cubes)
Object assembly (putting pieces together to make an object)

A comparison of the non-verbal skills of the two groups revealed the expected higher scores for the children with SLI in relation to the WS group. This difference was consistent through each subtest of the Wechsler Scale. This finding was consistent with Pinker's assertions.

However, the comparison of linguistic skills showed no significant differences to exist on any of the tests between the two groups, who both averaged between 1 and 2.5 SDs below the mean. Interestingly, the WS group performed worse than the SLI group on TROG (Test for the Reception of Grammar) and the Sentence Assembly subtest of the CELF-E (Clinical Evaluation of Language Fundamentals), although differences did not reach the level of significance.

Narrative samples of the children were also recorded and analysed in order to examine the microstructure of their speech in a more naturalistic context. Findings showed that although the WS children produced more overall words, the SLI children used more clauses, including subordinate clauses. An examination of specific grammatical markers which are regularly reported to be particularly problematic for children with SLI (Leonard *et al.* 1999, Rice *et al.* 1995, Rice & Wexler 1996, Bedore *et al.* 1998, Eadie *et al.* 2002) was carried out. It included the use of determiners, prepositions, plural *s*, genitive *'s*, pronouns, third-person sing., auxiliaries, *ing*-participle, *en*-participle, *ed*-regular past tense and irregular past tense forms. No difference was found in the marker use of the two groups except for the use of determiners, where SLI children performed more accurately than WS children.

This research supports claims for a difference in the general cognitive abilities of WS and SLI children, but its findings in the area of language testing find a general equivalence across the board between the two groups, with even occasional significant superiority in the language of children with SLI. This applies across the board in a variety of clinical tests as well as a microanalysis of free narrative. These results directly conflict with Pinker's assertion of WS children's strong linguistic competence and in turn negate his claims of double dissociation which he reports in relation to the two groups.

4. PROBLEM NUMBER FOUR: NEURAL SPECIFICITY DOES NOT PROVE MODULARITY. As reported above, Pinker's argument is based on a declaration of opposite profiles of cognition and language in two clinical groups. Already this has been brought into doubt. The argument follows that if a double dissociation did indeed exist, this would prove, or at least strongly support the notion of the modularity of language. This fundamental idea needs to be reconsidered. It is true that Fodor (1983) lists a fixed neural structure as one property of modules. However, he also lists several other requirements such as domain specificity, speed, information encapsulation, and shallow output. Therefore, a double dissociation

which would support the finding of a neural differentiation between two tasks does not tick all the boxes required by Fodor's list.

So what, if anything, does the neural specificity of a task tell us about underlying brain function? Does the existence of neural architecture specific to a task reflect the existence of modules which have been programmed into the child's genetic make-up as Pinker implies? Assumptions of nativism are commonly present in writings on the topic of modularity, most likely stemming from Chomsky's (1980) 'poverty of the stimulus' argument and reinforced by studies indicating aggregation of language impairments within extended families (Byrne *et al.* 1974, Gopnik & Crago 1991). This nativist assumption has, however, been called into doubt.

Müller (1996) approaches the claim that neural circuits are genetically predetermined by explaining the large amount of programming that occurs in the brain, not only by the genome, but also by glial cells, ion channels, nerve-growth factors, cell adhesion molecules and hormones. While admitting the planned specificity of particular areas of brain architecture, he (1996:623) also insists that 'there is no reason to resort to rationalist notions of innate ideas or to the modern metaphor of a genetically programmed hard-wiring', insisting that the truth, when known, will end up somewhere between nature and nurture.

Müller discusses the fact that many dozen genes are known to influence human linguistic abilities but emphasizes that their effects are not necessarily limited to the realms of language. Furthermore, he discredits the idea of predetermination of the role of particular brain areas and individual neurons by considering the exceptional plasticity shown in brain-damaged children who go on to develop normal language skills, emphasizing the fact that of motor, visuo-spatial and linguistic capacities, it is the last that is by far the most plastic.

Karmiloff-Smith (1992) attempts a possible reconciliation between the nativists and non-nativists by accepting the existence of modules but denying their genetic programming. Instead, she sees modularisation as a process carried out through a child's development, in which neural specificity is due to biological convenience. Brain circuits become domain-specific over an extended period of time due to their repeated selection.

As in the nativist theory, Karmiloff-Smith's approach accepts the importance of the interconnection between biology and the environment but changes the role played by each. Where the nativists see the environment as a trigger to biologically innate processes, Smith sees the similarity of development of children across the world as being dependent upon the homogeneity of their environments. It is the combination of the environment along with a very limited amount of 'innately specified predispositions' which allows capacities to develop.

5. CONCLUSIONS. This paper has examined Pinker's view of language as a modular system that is separate from overall cognition. As evidence for linguistic modularity, he presents what he claims to be a double dissociation between Williams Syndrome and Specific Language Impairment. The overall conclusion reached here in regard to Pinker's assertions is one of scepticism based on several reasons.

Firstly, the notion of double dissociation was discussed. It was found that no study can claim a total dissociation of language and cognition based on WS and SLI. Only a partial dissociation can be shown.

Secondly, the idea that all Williams Syndrome patients have diminished cognitive capacities is challenged.

Thirdly, the question of whether WS children have normal language skills was raised and it was shown that much evidence refuting the these claims of normality casts doubt on Pinker's argument. Therefore, the idea that Williams Syndrome and Specific Language Impairment show a skill-based dissociation of language and cognition is questionable.

Finally, it is argued that even if a double dissociation was proven to exist, that this would not necessarily be proof of modularity but instead indicates a neural specificity which is not necessarily innate.

The overall conclusion is not an argument against modularity *per se*, but as a negation of one of the more popular arguments presented in support of the thesis of linguistic modularity.

Careful examination of clinical linguistic cases and its combination with neuro-imaging are most likely to lead to advances in our knowledge of the mind and language, particularly in exploring our definitions of modularity in an attempt to find the appropriate paradigms for future study.

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[1] Note that the inclusion of pragmatic problems within the diagnosis of SLI is still debated.

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III

LINGUISTICS AS SCIENCE

HUMAN LINGUISTICS AND REFERRING IN THE REAL WORLD

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REFERENCE IS A CONCEPT which has been defined from different perspectives in philosophy as well as in linguistics. Most existing definitions of reference are based in the philosophy of language and revolve around words being used to refer to things in reality. Words are defined as items that name the things in the external or imagined external reality.

In the past, prominent authors of philosophical, scientific and fictional texts have addressed the issue of the weakness of these philosophy-based definitions. They have doubted the traditional notion of treating a word as an independent and powerful entity which has or carries meaning, refers to things in the real world, and causes responses in humans. They rather pointed to the importance of the involvement of the human being in the treatment of reference as the scientifically sound object of study in this matter.

Socrates' concern, for instance, was that there was a lack of real-world evidence that words as such possess the power they are assigned by philosophers. He pointed out that the nature of words is such that 'it demands a social convention and previous knowledge related to the intended meaning of the word in order to be used successfully and effectively' (Hamilton & Cairns 1961:467). Words as such bear no likeness to the objects they are a representation of. On their own, words are just letters and syllables, or in modern terms sound waves or ink on paper. On the other hand, by means of convention, one can 'choose to call great small and small great, as long as the parties involved are agreed on it' (*ibid*).

The father of modern science, Galileo, was concerned with divorcing the hard sciences from the idea that words have the kind of power with which they are endowed by philosophers (Drake 1980:71). He expressed his basic concern in the form of the witty remarks made in reference to using words as names which function as representations of real-world objects, as is the case in the following well-known quotation: 'If their opinions and their voices have the power to call into existence the things they name, then I beg them to do me a favour of naming a lot of old hardware I have about my house "gold"' (*ibid*).

And Shakespeare's famous 'What's in a name?' speech from *Romeo and Juliet* similarly expresses a doubt concerning the powerful use of names. It is the people as real-world objects who assign certain characteristics to the names of Montague and Capulet in the play, not the names themselves: 'That which we call a rose by any other name would smell as sweet'.

1. REFERRING IN HL. The subjects of reference, as it is called in the tradition, or referring behavior, as it is called in human linguistics, are discussed in Human Linguistics (HL) by Yngve (1996:ch. 21) and the distinction between the traditional and the HL notions is made by Burazer (2004b). It has been established that in the tradition, it is the words and

propositions that refer to real-world objects; it is the words that point to things in the environment. In HL, it is people who refer, not words (Burazer 2004b:ch. 8), therefore we speak of referring behavior of people rather than of words referring to objects.

1.1. THE CONTEXT OF SITUATION AND THE DOMAIN OF CONTROL. When speaking of referring, the tradition inevitably brings into the discussion the relevant context on which the use of words depends. In HL, this dependence on the context is addressed from the point of view of the human being and the relevant procedures in them that become active, stand ready or nearly ready to be triggered, which together constitute the participant's DOMAIN OF CONTROL. Therefore the term domain of control in HL covers what the tradition has called the context of situation, involving all the factors relevant to a particular communicative event, including the participant's background or past experiences, which represent the basis for the domain of control. To illustrate how the subjects of referring and consequently the domain of control are treated in the HL analysis, we take a closer look at the example of the game of tag.

The game of tag is a simple communicative activity involving a number of players where one of the players is 'it' and the others are 'not it'. In the HL approach we first define the game in terms of the physical reality—the real-world objects involved in it, which is the assemblage consisting of the playground and the children on the playground who are involved in the game of tag.

We set up the linkage [playground] with role parts for each of the children in the assemblage on the playground, formalized in the theory by the use of square brackets for systems as in (1) (Yngve 1996:ch. 13).

(1) [playground] = [Al] + [Butch] + [Carl] + [Dan] + [Eric]

The above notation is a theoretical representation of the real-world entities involved in the game of tag. The relevant linguistic properties of the linkage and the role parts are formalized in the theory by the use of angle brackets, as are the playground activities which are represented in the theory as linkage tasks and subtasks.

The game of tag is a relatively simple communicative activity, particularly in the linguistic sense, with no or very little verbal communication involved—such as the optional sounds of 'tag' and/or 'you're it' uttered by the player who is 'it' after having touched/tagged one of the players who is 'not it'—yet the activities consequently triggered in the participants are manifold and complex.

1.2. LINKAGE TASKS AND SUBTASKS. The role-part conditional property of being 'it' is a dynamically changing one, frequently alternating its value in the course of the game in accordance with the relevant tag linkage activities. These are represented in theory by the linkage task procedures being executed in the participants' plexes. In HL, plex is a 'representation of the structure of a communicating individual as a long list of procedures all interrelated by categorial and conditional properties in a complex dynamic causal network' (*ibid*:171).

The main task of the players whose 'it' property is at the 'not it' value is to <avoid the player who is 'it'>. The main task of the player whose 'it' property is at the 'it' value is to chase the other players. The touch of the player who is 'it' results in the change of the properties of the player that has been touched and of the player doing the touching. The conditional property of being it changes its value for the player touched from 'not it' to 'it', as formalized by the setting procedure in (2). Simultaneously, the conditional property of being 'it' changes from 'it' to 'not it' for the player who was 'it'. Both of these characteristics and their changes are presented in (2). Note that the players also have other tasks active in parallel not directly related to the value of their 'it' property.

(2) [X]<it> x [Y]<-it> x [X]<touch>[Y] :: [X]<-it> x [Y]<it>

1.3. INTRODUCING ORTHOCONCEPTS. The tag linkage task procedures are expected activities conditioned by the rules of the game. They execute as a result of the expectation procedures active in the participants' plexes in the course of the game, which have formed on the basis of the participants' past experiences with the game of tag. In the course of the game, the child monitors the activities and the corresponding changes in the participants' value of the conditional it/-it property by tracing the participants' tagging activities. On the basis of knowing how to play the game of tag (cf. example 2 above) the child knows how to interpret the relevant activities on the playground. He knows who is 'it' and that the participant who is 'it' needs to be avoided. The child remembers the player who is 'it' visually in an orthoconcept which has been defined in HL as concepts about the real world as they have been initially recorded in the course of the individual's experiences. It is important, though, to clearly separate the term orthoconcept from the traditional notion of concept. As pointed out, othoconcepts are concepts about the real world as perceived and recorded by the individual on the basis of previous experience and as a result of recognition. They are properties of systems in a particular linkage. 'Concepts (orthoconcepts in HL) are not free standing abstractions. Orthoconcepts are properties in a theory in a real observer that model a physical reality and require an observer in which to form' (cf. Yngve 2006).

In line with the above notation for the game of tag (1) and the setting procedure of becoming 'it' (2), we can further formalize the game of tag by including the notation for the individual participants' orthoconcepts of the particular game of tag. Such a notation clarifies the procedures and the changes in properties in the linkage participants and sheds light on the possibilities of formalizing referring behavior in HL.

Each participant in the tag linkage has the orthoconcept of the game of tag, in this case a property (a) of [Alex] would be: [Alex]<playground = [Alex] + [Butch] + [Carl] + [Dan]<it> + [Eric]>. At the same time, Alex would have the property of the other participants sharing this orthoconcept of the game, such as property (b): [Alex]<[Butch]<playground = [Alex] + [Butch] + [Carl] + [Dan]<it> + [Eric]>>. If Dan, who is 'it', tags another participant in the linkage, the orthoconcepts change accordingly. If Dan, for example, tags Carl, the orthoconcepts of the game change. Thus Alex's orthoconcept [Alex]<playground = [Alex] + [Butch] + [Carl] + [Dan]<it> + [Eric]> changes into [Alex]<playground = [Alex] + [Butch] + [Carl]<it> + [Dan] + [Eric]>, where Carl is now 'it'. Similarly, Alex's

property of sharing the orthoconcept [Alex]<[Butch]<playground = [Alex] + [Butch] + [Carl] + [Dan]<it> + [Eric]>> changes into [Alex]<[Butch]<playground = [Alex] + [Butch] + [Carl]<it> + [Dan] + [Eric]>>.

The linkage participants' activities propagate changes in their properties, which are properly signaled so that the other participants involved can undergo appropriate changes in their relevant properties. This signaling of the changes in properties and appropriate synchronizing of the other participants' properties can in HL be seen as referring behavior.

1.4. FOCUSED LINKAGE AND LINKAGE TYPE. As it has so far been established, orthoconcepts form as a result of recognition in a particular linkage and are not generalizations. The fact that they form as a result of recognition implies that they form in an observer, which is a role part every participant in the linkage takes on in a parallel observing linkage. In order to follow the course of the game, the participants need to form orthoconcepts about who is 'it' at any point in the game. On the basis of observation of a number of instances of the game of tag then form generalizations of the observed properties.

The properties of the tag linkage can in HL be studied in a focused linkage. In HL, the focused linkage (Yngve 1996:§15.4) is defined in contrast to complete linkage, where the linguist focuses on studying just a few or even just one phenomenon in human communicating and includes just those properties needed for the study or explanation of that phenomenon (*ibid*:180). On the basis of the discoveries the linguist can then determine the linkage type, which is defined in HL in terms of two or more focused linkages whose identical categorial and procedural properties represent a linkage type (*ibid*:200).

In line with the above discussion of orthoconcepts and the example of the game of tag, linkage types are generalizations where the identical categorial and procedural properties of several corresponding focused linkages represent the constants in these systems, and the changing conditional properties correspond to variables in these linkages. The variables which are not observed in other instances of the game of tag are discarded in the sense that they are not a property of the LINKAGE TYPE. Only the properties which are observed in all focused linkages are properties of the linkage type.

It follows that linkage types are in theory generalizations about the real-world activities made on the basis of focused linkages with identical categorial and procedural properties. These generalizations become a part of the relevant individual's domain of control in the course of their communicating activities, together with the related expectation procedures.

By successfully referring to a participant's domain of control and the relevant expectation procedures related to the relevant focused linkages, the communicating individual is assuming and at the same time validating his assumption that the other communicating individual has a corresponding domain of control with similar generalizations or properties of linkage types. In the process of communicating, individuals are constantly monitoring for validation of each other's behavior in the form of the other participant's nods, responses and other expressions of agreement and understanding which gives them reassurance that similar linkage types are being accessed in the plexes of their partners in communicating, forming a similar domain of control. Therefore human communicating is based partly on expectation procedures in those involved in a relevant communicative situation,

which are that the other participants have the orthoconcepts and the generalizations forming the relevant domain of control.

2. HUMAN BEHAVIOR AND 'RULES'. Past observations of human communicative behavior have led to a discovery of patterns of communicative activities. Human behavior has thus been compared to games such as chess, by Saussure and Wittgenstein, or football and baseball, by Searle, suggesting that speaking a language as part of communicating is a matter of performing speech acts according to systems of constitutive rules (Searle 1969:38). Violating the rules of a game results in negative attitude towards the particular player or team. Generally, in social behavior such violations of or adherence to the rules (of etiquette) might represent the basis for appraisal of behavior, such as 'he was rude,' 'he was immoral,' 'he was polite,' which Searle tentatively poses as evidence for the existence of 'rule governed' human behavior.

We can claim with some certainty that there is evidence from everyday examples that human behavior is in fact rule governed, although this expression in itself represents a domain confusion and as such is not a part of terminology used in Human linguistics. These so called rules are forms of socially accepted human behaviors, in most cases observed and learned by individuals in their course of communicating. However, at this point, they cannot be considered as a scientific fact or proof of the lawful nature of human behavior, but only as an observed social phenomenon. Rules as such may influence human behavior and familiarity with them may result in forming certain expectation procedures in communicating individuals, but in reality, rules are merely an expression of the society's expectations. Namely, even the laws defining criminal behavior are not a guarantee that people will behave in a socially acceptable and non-criminal manner. Laws are being broken every day. Apart from the state legislature which defines legal boundaries of behavior, it is also the society that dictates certain ways of accepted behavior and consequently condemns deviations from these ways as unacceptable. In reference to these socially defined rules of behavior, it is only human nature to have the need to belong and be accepted by the society that conditions conformity to norms in human behavior.

The rules of socially accepted behavior undergo considerable changes through time. Numerous everyday examples support this statement. In the past, for instance, before the existence of modern telecommunication systems such as telegraphs, telephones and the electronic media, people used to communicate through messengers or through the postal service. So, for instance, arranging to meet someone took quite a while if one wanted to come announced, in addition to observing certain norms of social behavior. Then, with the invention of the telegraph, getting a message through to someone became considerably easier and quicker, and even more so with the invention of the telephone. Showing up at someone's doorstep all of a sudden became incredibly rude, at least in my experience. The social norm became *You should call first.* If one did happen to show up at someone's doorstep, one would have noticed a change in the prospective guest's communication from *I'm so glad you're home* to suddenly apologizing *Sorry, I know I should have called first.*

Nowadays, in the time of mobile telephones and electronic mail communication, it might be unimaginable to just show up at someone's doorstep, even if you did just happen

to pass their house. The rules of social behavior dictate that it is polite and expected of you to call first, even if you're standing right in front of the person's doorstep. The availability of modern means of communication has changed people's perception of what can be expected of other people in terms of making interpersonal communication easier, so a certain level of predictability of human behavior is expected.

Similarly, expectations have changed in terms of decoding the meaning of sounds such as music heard in the middle of the street or in a classroom, or a person talking to themselves in a coffee shop. Some time ago, these instances would have probably been understood as some sort of deviations from the social norms of behavior. Nowadays, the first expectation when music is heard seems to be that it must be someone's mobile telephone or an I-pod or some other modern portable electronic device. And if one hears someone walking behind them and talking loudly, one expects they are talking to someone on the phone rather than addressing one or talking to themselves.

Validation and appraisal of our past behavior results in forming certain social expectations in people. These are conscious and can be expressed or even made the subject of manuals of etiquette and handbooks of acceptable behavior in society. And as such they belong to the realm of the soft sciences.

The HL defined expectation procedures are in large part automatic and below the threshold of conscious awareness. They form in an individual's plex and are triggered in a particular situation, in relation to the appropriate related orthoconcepts and generalizations. On the basis of expectation procedures, the appropriate task procedures are triggered in the course of communicating, in accordance with the individual's social and cultural experience, which is the subject of study in the hard sciences.

3. ACCOUNTING FOR SUCCESSFUL REFERRING. Although people share some common ground, they come from different backgrounds. This brings us to the question of how it is at all possible for any human communication to be successful, since our personal histories differ and thus contribute different input into the domain of control. Other linguists have expressed this fear for the process of making linguistics scientific. Bloomfield, for instance, feared that 'the occurrence of a speech… depend[s] upon the entire life-history of the speaker and of the hearer' (in Yngve 1996:170). But the HL theory eliminates these fears because it finds that communicative behavior is lawful, which means that 'it is possible to discover the laws related to any given piece of communicative behavior, and thus achieve a scientific understanding of it' (*ibid*:171). Note that laws are not rules and we should be careful not to confuse the two. The efforts in HL research are well underway to discover the laws of communicative behavior, but so far we can only speculate tentatively that people expect conformity to norms and easily overlook deviations or actually hear them according to their expectations (cf. Burazer 2004b), otherwise human communication would in most cases result in failure.

Success in referring behavior is conditioned by the domain of control in the participants in a particular linkage. This does not imply that participants have the same life-history, which is of course impossible, but we are rather counting here on the principle of

equivalent componential histories relating to the particular domain of control, as pointed out in Yngve (1996:169). This means that:

> In formulating laws of communicative behavior in HL we do not need to be concerned explicitly with the entire life history of the speaker and of the hearer... On the contrary... the irrelevant aspects of the life history of a person can be ignored on the basis of the law of restricted causation, and the inessential differences... can be ignored on the basis of the principle of equivalent componential histories' (*ibid*:170).

4. CONCLUSION. In human linguistics, referring behavior is concerned with the triggering of procedures in dependence on the context rather than with people using words (*ibid*:277), or people following rules, as in traditional linguistics. In human linguistics, participants do not refer to elements or words in the text. It is orthoconcepts in the hearer or reader role part's domain of control that are involved in the course of communicating. These relate to items in the external reality (such as tag players in our example) or in the imagined external reality or abstract items (such as the game of tag). A certain given communicative behavior may involve different properties belonging to different parts of the plex at different times depending on the domain of control.

The words reference and referring constitute a part of terminology in many different fields of research and we, the readers/listeners, manage to adjust their specific meanings in accordance with the field of research in question. Definitions from philosophy imply that it is words that refer to or point out objects and other worldly phenomena. Conversely in human linguistics it is not words but people who refer or point to something, therefore people should be made the object of scientific study of linguistics.

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A FORMAL INTEGRATED VIEW OF SPEECH, GESTURE, GAZE AND ITS IMPLICATIONS FOR LEARNING

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Lieberman argues convincingly (2000 *passim*) against modular linguistic theories which have created by assumption a distinct language organ. He cites Chomsky (1980a, 1980b, 1986), and Fodor (1983) as examples; in fact, the modularity assumption is still current, and has been restated or invoked repeatedly over the years since it was introduced by Chomsky (1964) over forty years ago. This has been made particularly clear in most theoretically-couched discussions of language learning, e.g. by Sharwood Smith (1985); White (1989); Cook (1993); Sharwood Smith (1994); Flynn, Martohardjono and O'Neil (1998); Chomsky (2000); Gass and Selinker (2001); and Carroll (2001). The neurological and behavioral evidence, however, shows the strict modularity assumption to be false. As Lieberman puts it, 'the neural bases of human language are intertwined with other aspects of cognition,[1] motor control, and emotion' (2000:2). The interdependence of these various networks has serious theoretical as well as practical implications.

In the present study I show how the interconnectedness of the various sensory-motor modalities is key to understanding how people actually learn to communicate via the neural mechanism of associative learning. In doing so, I show why certain input-based approaches in foreign language learning in fact provide adequate input while others do not.

1. A model of a 'natural approach' classroom interaction. I start with an example of a simple communicative event—part of a Natural Approach (NA) foreign language lesson (see, e.g., Terrell 1977 *passim*) and show how one participant's linguistic behavior can be adequately modeled only by considering interconnected events across the modalities of speech, gaze, and gesture. The model is presented in the form of a Hard-Science Linguistics (HSL) **plex** (Yngve, 1996:171) of a **communicating individual** (Yngve 1996:124). The plex of a communicating individual is a representation of the physical-domain properties of a person relevant to his/her ability to communicate. Values of properties and the cause-effect relationships among them are formulated in terms of a network formalized using Boolean notation. Events are represented as Boolean pulses and conditions, as Boolean levels on connecting paths within the plex. I will show how, during a communicative event such as the one in question, these pertain *across* the sub-networks within the plex corresponding to the modalities of speech, gesture, and gaze.

A core component of an NA classroom linkage proceeds as in the following. A teacher (in this case, female) stands at the front of the room, next to a table, near the blackboard. The students sit facing her. On the table are several objects: a pencil, a book, and so on. She picks up a pencil, briefly making eye contact with various students, making sure she has

their attention. Pointing at the pencil, she glances at it briefly, and articulates [tojestowuvek]. Laying the pencil back on the table, she picks up a book. She glances at the book while briefly pointing at it, but this time she articulates [tojestkśõška]. She returns the book to its place, and while simultaneously glancing down at the table and touching it with her hand, articulates [tojeststu:]. Next the teacher glances up, points at the ceiling, and articulates [tojestsufit].

2. ASSOCIATIVE LEARNING IN THIS SITUATION. In the segment of Natural Approach classroom linkage just described, there are several iterations of the same linkage tasks.

Each time, a correlated set of events has occurred involving speech, gesture, and directed gaze. The teacher has brought an object into salience for the students by means of gesture and directed gaze. She has performed a similar articulation—[tojest]; from this, there is **at the neurological level internal within the students**[2] an association formed between the gesture(s), directed gaze, and this speech event.

In addition, some events have occurred which distinguished each iteration. The teacher articulated [owuvek] while glancing at / holding up / pointing to the pencil, [kśõška] while glancing at / holding up / pointing to the book, [stu:] while glancing at / touching the table, and [sufit] while glancing at / pointing to the ceiling. From this, an internal association will occur between the neurological events resulting from the perception of each articulation [owuvek], [kśõška], [stu:], or [sufit] with the perception of anything in the same cognitive-perceptual category as the pencil, book, table, or ceiling, respectively.[3]

3. A (PARTIAL) FORMAL DESCRIPTION OF THE EVENTS. The following description, given the inherent limitations of space, is necessarily presented only in overview.

Figure 1 shows—in HSL Boolean network notation—the portion of the teacher's procedural properties relevant to her ability to take part in the portion of the NA classroom linkage of particular interest here. A pulse enters on the line at left and initiates the task procedure <Establish Attention>,[4] goes from there to the task procedure <Establish Salience>, from there to the task procedure <Name>, and from there to the task procedure <Release>. The task procedure <Establish Attention> has subtasks in the perceptual system by which the teacher establishes that students are attending to her. The task procedure <Establish Salience> sends a pulse (σ-pul) that initiates subtasks in motor-sensory systems related to speech and gesture. The task-active line of <Establish Salience> is a conditional property (Prop-Directed-Gaze-lev) relevant to motor-sensory processes controlling directed gaze; when <Establish Salience> is active, this property is TRUE.[5] Feedback from the gesture and speech subsystems, respectively, is in the form of subtasks-done pulses ϕ1-pul and ϕ2-pul (connected by an AND-collector: an AND gate which does not need to receive its pulses simultaneously). The subtasks-initiating pulse ν-pul and the subtasks-done pulse ϕ3-pul of <Name> are to/from the speech subsystem, while those of <Release>—ρ-pul and ϕ4-pul—are to/from the gestural subsystem. The output pulse branch ω-pul provides a signal to the directed-gaze subsystem, allowing its release from linkage-related tasks (see the description accompanying **Figure 2**). The diagram in **Figure 1** describes the overall events in the

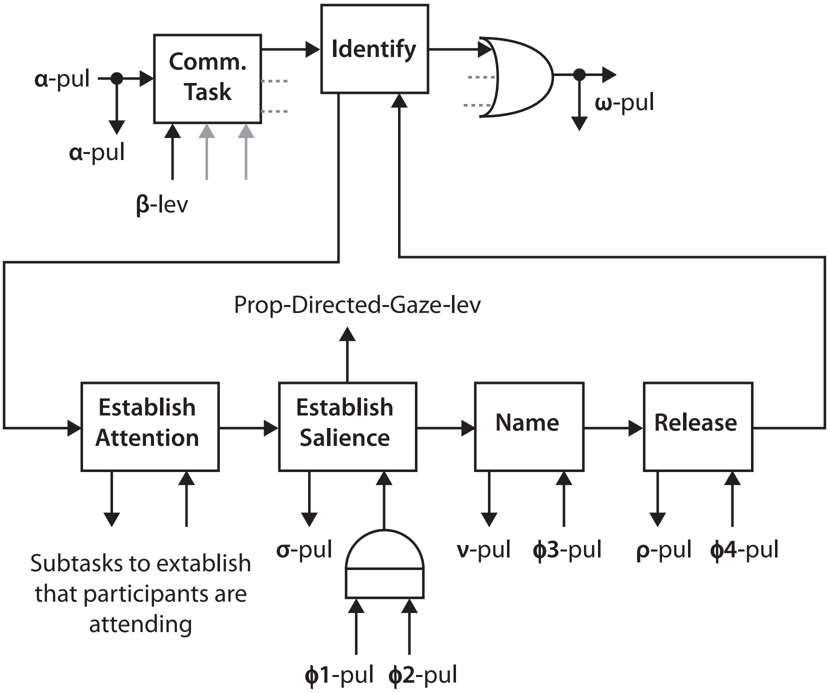

Figure 1. *Higher-order procedural properties in teacher plex.*

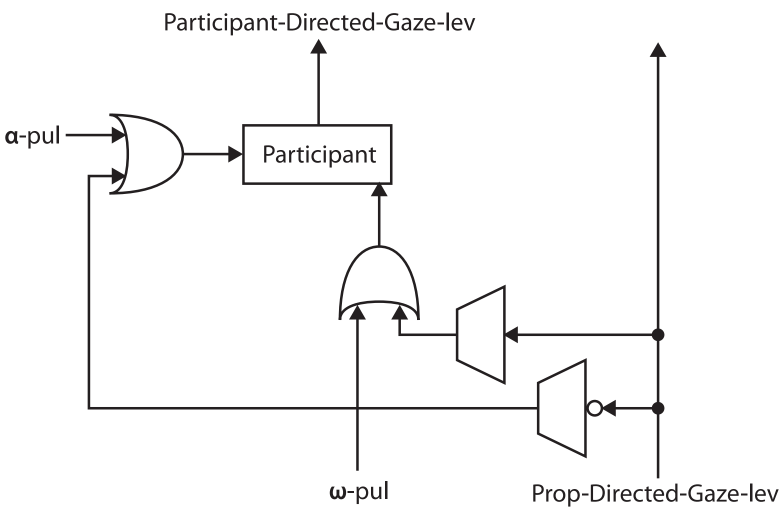

Figure 2. *Part of the directed-gaze subsystem of the teacher's plex.*

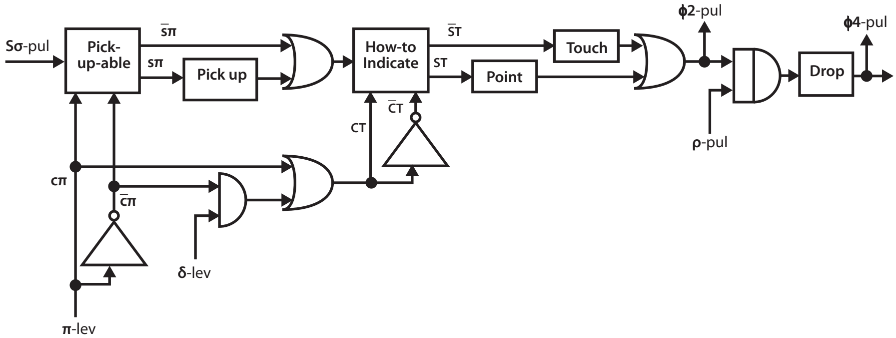

Figure 3. *Part of the gestural subsystem of the teacher's plex.*

teacher's plex relevant to her speech, gesture, and directed gaze during this short linkage segment, as they are described in the earlier narrative.

Figure 2 shows relevant procedural properties from the directed-gaze subsystem of the teacher's plex. The input pulse which initiates <Establish Attention> in **Figure 1** is synchronized with α-pul, shown here in **Figure 2**. The pulse passes on to <Participant>, which functions as a pulse-to-level converter. When Prop-Directed-Gaze-lev undergoes a transition from Boolean FALSE to TRUE, a level-to-pulse converter (the upper-left of two gates shaped like trapezoids in **Figure 2**) passes a pulse input through an OR gate to the input on the bottom right of <Participant>, temporarily resetting Participant-Directed-Gaze-lev to FALSE. When Prop-Directed-Gaze-lev, on the other hand, undergoes a transition from Boolean *TRUE* to *FALSE*, a second level-to-pulse converter (the lower-right of two gates shaped like trapezoids in **Figure 2**, the one with a circle indicating its input is inverted) passes a pulse input through an OR gate to the input on the left side of <Participant>, resetting Participant-Directed-Gaze-lev back to TRUE. Participant-Directed-Gaze-lev remains at Boolean TRUE until there is a pulse ending the linkage segment normally (ω-pul).

Figure 3 shows relevant procedural properties from the gestural subsystem of the teacher's plex. Sσ-pul is connected (with some additional elements in between) to σ-pul in **Figure 1**. Most of the logic of **Figure 3** is devoted to showing the interactions between the conditions π-lev (TRUE if the teacher's cognitive system judges the prop being brought into salience able to be picked up) and δ-lev (TRUE if the prop is too distant to be picked up). Of particular relevance here, however, are ρ-pul and ϕ2-pul, at the right of the diagram, which also connect the procedural properties of gestural subsystem to the higher-order procedural properties shown in **Figure 1**. The connection via ϕ4-pul is discussed later.

Figure 4 shows relevant procedural properties from the speech subsystem of the teacher's plex. SAσ-pul is connected (with some additional elements in between) to σ-pul in **Figure 1**. The task <To> has subtasks (not shown) which handle the portion of the articulation represented above as [to]. When this task is completed, a subtasks-done pulse (ϕ1-pul) is returned to the higher-order task properties in **Figure 1**. As soon as ϕ1-pul (from the speech system—**Figure 4**) and ϕ2-pul (from the gestural system—**Figure 3**) have both been received by the higher-order task procedure <Establish Salience> (**Figure 1**), the

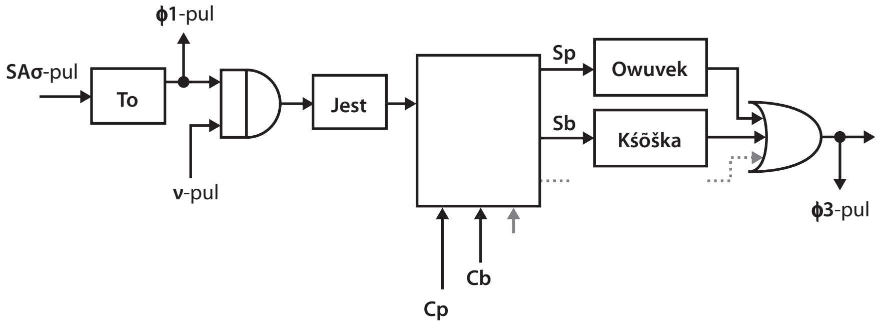

Figure 4. *Part of the speech subsystem of the teacher's plex.*

higher-order task <Name> initiates, sending an initiate-subtasks pulse on ν-pul (**Figures 1** and **4**). At this point, a pulse will proceed in the speech subsystem to the task <Jest>, whose subtasks will result in the articulation represented above as [jest]. When <Jest> is done, a pulse continues on to the selection procedure in the center of **Figure 4**. For the sake of simplicity, only two conditional properties are shown, Cp and Cb, where the p and b stand for speaker reference to pencil and book, respectively. Depending on which conditional property is Boolean TRUE, the corresponding output line (Sp and Sb) will carry a TRUE pulse. The immediate outcome will be that either the task <Owuvek> or the task <Kśõška> will be initiated, in turn resulting in either the articulatory events represented as [owuvek] or [kśõška], respectively. Regardless of which articulatory task is performed, a pulse passes on to the OR gate at the far right of **Figure 4**, causing a subtasks-done feedback pulse to be sent back to the higher-order task <Name> via ϕ3-pul (**Figures 1** and **4**).

Note that it is the <Drop> task in the gestural subsystem (**Figure 3**) which returns a subtasks-done pulse via ϕ4-pul to the higher-order task <Release> (**Figure 1**), effectively concluding an iteration of the linkage portion.

What this model is intended to demonstrate is that the intimate and—highly relevant—interdependencies among the speech, gestural, and directed gaze subsystems can be formally described, using HSL Boolean network notation.

4. THE CRITICAL VALUE OF THE CORRELATED EVENTS. Twenty years ago, Klein (1986:44) made the following observation:

> Suppose you were locked in a room and were continually exposed to the sound of Chinese coming from a loudspeaker; however long the experiment continued, you would not end up speaking Chinese...

As Klein's Chinese Room anecdote illustrates, the 'input' for the students cannot consist of Chomsky's (1964:26) 'primary linguistic data'.[6] The input for learning to communicate—what we conventionally call language learning—includes 'the information received *in parallel* to the linguistic input in the narrower sense (the sound waves [of speech])' (Klein 1986:44). Thus, it is clear that we should be integrating into our formal descriptions such

information as is included above, especially if we are to understand how people actually learn to communicate.

5. TWO 'INPUT-BASED' APPROACHES. Terrell's (1977) Natural Approach incorporates what is needed to prevent the classroom from being Klein's (1986) Chinese Room. In the Natural Approach, the perception of speech or writing does not occur in isolation from people communicating, but is linked to gestural and directed gaze behaviors of the teacher (and sometimes of the students) and to objects present in their environment.

Now consider another supposedly input-based approach: the 'grammar-processing approach' of VanPatten (1996:2). In discussing the role of input, VanPatten clearly accepts Chomsky's assumption of input as consisting of the primary linguistic data. VanPatten (1996:6)states, 'The definition of input is limited to meaning-bearing input, language that the learner hears or sees that is used to communicate a message.' Note that meaning in VanPatten's view is not something that depends on the properties of people (which we might represent in terms of the plex of a communicating individual) or their interactions (which we might represent as linkage properties), but is something that can exist apart from people, borne by input—which purportedly consists of language. He elaborates quite a bit on this point, identifying input as 'restricted to samples of second language that learners hear or see to which they attend for its propositional content' (VanPatten 1996:10). He assumes that the input consists of words and grammar. But if it did, then we would learn Chinese in Klein's Chinese Room.

There are some immediately significant consequences for VanPatten's input-processing theory. For example, he draws up a number of principles for his theory, such as 'P1(a): Learners process content words in the input before anything else' (VanPatten 1996:18).[7] The reader is cautioned that if this principle appears self-evident, he (or she) should keep in mind that—in any real-world sense—the input actually consists of sound waves, light waves, kinetic energy, and the like, all of which impinge on the learner's body and cause internal changes of state describable in physiological (and especially neurobiological) terms. Words, on the other hand, are mental objects, which therefore exist only in the logical domain (and thus in a person's conscious subjective experience). It is curious that VanPatten never notices that in order for P1(a) to make sense, the learner somehow needs to know what the words in the input are (supposedly in an unknown language); nor does he take up the issue of how the learner could know which words in the input are content words and therefore should be processed first; nor does he explain how input purportedly consisting of samples of language unknown to the learner can be meaningful to him/her; and so on. In short, from a theoretical perspective, input processing suffers from the presence both of unsupported assumption and self-contradiction.

In his chapter 'Processing Instruction', VanPatten (1996:55–86) presents a number of examples of activities for processing instruction which

> utilize what is best termed 'structured input.' 'Input' refers to the fact that during the activities, learners do not produce the targeted grammatical form or structure. Instead, they are engaged in actively processing input sentences. (63)

Actividad J: Los parientes. What are the things that relatives do to us?
They can bother us, visit us, criticize us, love us, and so on.

Paso 1. Read each statement and select the ones that you think are typical.

Los parientes...

- a. ☐ *nos molestan.*
- b. ☐ *nos critican.*
- c. ☐ *nos ayuden* (help).
- d. ☐ *nos visitan.*
- e. ☐ *nos quieren* (***querer*** = to be fond of).
- f. ☐ nos ___________.

Figure 5. *A 'structured input activity' (VanPatten 1996:66).*

Figure 5 shows a typical example from VanPatten's book (ibid:66). This activity is among those explicitly described as providing 'structured input' (ibid:63–64). In it, we see three different types of translation cues. The first is contained within what purport to be the instructions for the activity ('They can bother us, visit us, criticize us, love us, and so on'); this is directed specifically at *molestan*, *critican*, and *visitan* in (a), (b), and (d), respectively, three items of the activity not cued within the activity itself. Clearly, this is to prevent the false cognate syndrome in the first case and to tell students that the other two are true cognates. The other two complete items—(c) and (e)—are translation-cued within the activity itself, albeit in slightly different ways; this is almost certainly attributable to the grammatical irregularity of *quieren* in item (e). The presence of these cues implicitly admits the falsehood of the assumption that input consists of second language primary linguistic data in Chomsky's terms.

7. CLOSING REMARKS. VanPatten claims the input for second language learning consists of sentences containing words arranged in grammatical structures carrying meaning. If this were the case, the Chinese Room approach would work.

But I repeat, as Klein (1986) pointed out, it does not.

The assumption that input consists of the primary linguistic data is false. Rather, the input is the totality of a learner's sensory experience. Therefore, the so-called Poverty of Stimulus does not exist (see Coleman 2005).

An approach like that of VanPatten's must tacitly acknowledge its entry into the Chinese Room (typically via the presence of translation cues and similar hints), even if it makes explicit claims to the contrary.

In an input-based approach that works, one which provides adequate input for learning how to communicate, speech or writing must be viewed in terms of communicative interactions (linkages) that include correlated events between/among 'the linguistic input in the narrower sense (the sound waves [of speech])' and 'the information received *in parallel*' to it (Klein 1986:44).

This is because traditional, language-focused approaches to understanding how people communicate formalize only the mental objects of grammar (grammar in the broad sense), which exist only in the logical domain. But as shown above, there are real-world (physical-domain) events and properties of people relevant to our understanding of the situation. Because people and the communicative events they are involved in exist in the physical domain, traditional language-based approaches (which confine themselves to the logical domain) permit only vague and imprecise appeals to extra-linguistic context. Let us suppose that what the field of linguistics has as its ultimate goal is a useful, scientifically-based model of how people communicate. If so, we must turn away from the logical domain and accept that it is not language, but what we marginalize as context (people communicating in their surroundings) that properly concerns a science of linguistics.

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1 It is clear from the discussion that follows in Lieberman (2000:3–11) that he includes under 'other aspects of cognition' neural processes associated with sensory input.

I refer just above to the **strict** modularity assumption because, as one anonymous reviewer of this paper helpfully pointed out, 'the neurological evidence also shows that neurons performing tasks with similar functions are grouped in a kind of natural efficiency'. Indeed, this is one of Lieberman's key points—and that these groupings in no way constitute parts of a 'language organ'. For example, '[a] particular structure, such as the putamen (part of the subcortical basal ganglia), can control similar sequencing operations in manual movements [and] speech production', i.e. both non-linguistic and linguistic functions (Lieberman 2003:10).

2 The following is to insure that there is no misunderstanding: this internal association at the neurological level is not to be equated with an external S→R association as conceived of by, say, Bloomfield (1933). Behaviorist S→R theory, in fact, denies the relevance of not-directly-observable internal processes, confusing the not-directly-observable with the abstract. For discussion, see Coleman (2004).

3 Obviously, the cognitive category with which the perception of any pencil, book, table, or ceiling is attached depends on each student's internal properties, a result in part of individual prior experience. If the student lacks the neurological structure associated with a cognitive-perceptual category 'pencil', then perception of [owuvek] will be associated with whatever cognitive-perceptual category pre-exists for the perception of the pencil in the teacher's hand. I am thinking, of course, of cases in which the student's prior experience may have resulted in a cognitive-perceptual category which includes pencils but not mechanical pencils; one which includes pencils, chalk, charcoal, but not pens or brushes; etc.

4 When I refer to a line being at a certain level, I mean it is stable at Boolean TRUE or FALSE in contrast to a line carrying a pulse, which is typically FALSE until it only momentarily goes to TRUE, then reverts to FALSE. When I say that a task procedure is 'initiated' by an input pulse, I mean that (a) an output pulse is sent to its subtasks and (b) its task-active state becomes Boolean TRUE.

5 For the reader's convenience, individual line labels end with either 'pul' or 'lev' as a reminder as to whether they carry a Boolean TRUE pulse or TRUE / FALSE level.

6 Coleman (2005) discusses in detail the relevance of the Chinese Room anecdote and demonstrates, based on a number of reasons, why the input cannot be thought of as 'the primary linguistic data'.

[7] In linguistics (in this case an applied subfield), we often see such an enterprise being carried out riddled with principles which are posited and then taken as given. In such cases, it should immediately be obvious that the enterprise is in fact being conducted as philosophy, rather than science. In the latter domain, we instead see hypotheses offered up for testing in the real world.

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IS EVIDENCE BASED LINGUISTICS THE SOLUTION? IS VOODOO LINGUISTICS THE PROBLEM?

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Although this paper examines some relatively new aspects of linguistics, an attempt has been made to harmonize them with existing doctrines so as to minimize any possible negative impact. It is particularly felicitous that this should be an international conference with participants from many nations, and its joint sponsorship by Canadian and U.S. linguists is especially welcome. Canada's presence as a strong dissenting voice on our continent over several decades has been equally felicitous. Moreover, through Canada, LACUS is also a bilingual organization, et c'est la raison pour laquelle on voudrait aussi, pour commencer, rendre hommage à la langue et à la culture françaises.

1. Disclaimers and basic method. A few disclaimers are in order at the very outset, perhaps even something of an apology, since at least some of what follows might be perceived as negative about the last five decades of linguistics, though this does not necessarily apply to the future. If at first there seems to be a desecration of idols sacred to many in our field, an attempt will also be made to suggest a few truly scientific approaches to take the place of so much misplaced idolatry. And while some of these remarks might be more appropriate at an LSA conference than at LACUS, this could be because a few viruses from the LSA-MIT Petri dish have perhaps become so widespread that they have to some extent tainted the study of linguistics elsewhere as well.

During recent decades there have been concerted and repeated attempts to reformulate linguistics either as a branch of logic, or as a branch of philosophy, or of psychology, or sociology, or socio-psychology, or even of paleontology. Not to mention several different branches of math and statistics, especially computational mathematics, even to the extent of attributing mathematical precision to grammatical relationships, regardless of the context such relationships might be attempting to represent.

In this context it may be surprising but not entirely shocking to suggest that linguistics can be far better described as an offshoot of yet another science, not the most precise of studies, but a science nonetheless: the science of physiology, itself belonging to the study of medicine. My claim to competence here is grounded in two areas: first, some four years spent in the company of American doctors, nurses, and physical therapists in the detailed study of Chinese medicine, which means that I have to some extent acquired not merely medical but bi-medical knowledge and experience; second, from further experience, gained over a lifetime, of an extremely rare endocrine condition, resulting in perhaps limited achievements in some respects, but also a greater enrichment in others through a search for knowledge in a number of nations and cultures and areas of study. But this

presentation is not solely embedded in biological variables but includes more precise linguistic values springing from the cartographic dimension of language.

Perhaps most important, since this treatment is largely centered on the nature of evidence, there is no way of escaping the need to present credible evidence for every statement that may be advanced, even where evidence itself is concerned.

Yet even here there are some real limitations involved, leading to a further disclaimer. In 2005, the Edge Foundation challenged 120 of the world's top scientists to spell out what they themselves regarded as true, even though they had no real evidence to prove it. Every one of these eminent scientists came up with one or more notions they subscribed to, even where final proof was lacking (Edge Foundation 2005:*passim*). So despite the title of this paper, evidence may not always represent the final word or even be easy to gather and verify. Still, it is preferable to have more evidence backing up one's claims than little evidence or none at all, since the latter has sometimes come close to being a norm in our field.

As a final disclaimer it is also important to articulate what may be one of the thorniest problems that faces us whenever we try to discuss almost anything, including language itself: that language, by its very nature, can sometimes force even the most painstaking of observers into oversimplifying complex issues, often by pretending that there are only two possible views about any subject, or that there are only two theorists who are qualified to offer opinions, when there may in fact be many such views or informed observers.

Whenever any of us attempts to state something with the objective that it should mean close to the same something to others, there is often a risk of oversimplification. There is a real possibility that pressures inherent in the process of language use have placed me in something of the same position. It is difficult to emphasize one facet of reality without simultaneously ignoring many other aspects. Language itself may treat us all in this manner, perhaps more often than we are aware. This produces many problems.

To begin with one problem, it was claimed as recently as 1990 that by using machine translation (MT) systems unaided monolingual workers will perform 'truly automatic translation… without assistance from bilinguals, polyglots or post-editors… but meeting the quality standards of professional translators—no less'. Nor was this the only such extravagant claim (*Language Technology*, various issues, 1988–'90). Of course, this prediction never came true. The researcher who made this statement now runs a company specializing in Translation Memory (TM) systems, about which he make no such boasts.

The second and far deeper problem is that at present no MT or TM system can provide reliable translations even for set phrases without the editorial participation of professional translators, those very people whom Geoffrey Pullum and others predicted MT would soon be supplanting (Pullum 1991:19). Moreover, relatively few professional translators are willing to work with either MT or TM. In any case, MT now accounts for only about one percent of the roughly 450 million publication-quality pages translated each year. The third problem is that those who foresee an increase in this percentage tend to be market analysts having no knowledge of translation or language but merely react to the multi-billion dollar translation market. This is most probably why such claims keep cropping up and why funding continues to flow to those making them.

A more fundamental problem is the view of linguistics as the science of language, when it cannot possibly be. Linguistics is simply not a branch of science. It is in fact situated, along with language itself, on a far higher plane. Language is prior to science, both historically and logically, and to assert otherwise is to commit both a historical error and the classic Bayesian error of overlooking one's priors.

It is six decades since Louis Hjelmslev, the principal founder of Glossematics, made this matter amply clear (Whitfield 1969:291, de Beaugrande 2002:6.8–6.12). The primary science is in fact linguistics, including language itself, and even the allegedly lowly acts of translation and interpreting between languages. All other sciences have evolved from this original source. In other words, language is the science of all the other sciences, which in fact are derived from language as offshoots, branching paths, results, perhaps almost as afterthoughts.

Or in Giordano Bruno's words in 1603 at Oxford:

From Translation all science had its offspring
(Yates 1934:89, Pellegrini 1943:193).[1]

One need only pick up a math book to discover that many of its seemingly abstract statements come described in carefully structured language modules, a point also made by Scott Montgomery (2000:253–55). Language is of course historically prior to mathematics as well, as far as we know language has existed as long as our species, but most of what we term mathematics, far from being eternal, has come into use only over the last few hundred years, at best the last few thousand, and even then is shared by only a small minority among us.

Since all the sciences have in fact sprung out of language, this raises a crucial question: how are we to use language or linguistics as an investigative tool, as a so-called science, when it is already the primary creating, defining, and describing tool? Perhaps this was what that remarkable German Georg Christoph Lichtenberg, who somehow managed to be both a physicist and a noted satirist, meant when he said back in 1799:

Language originated before philosophy, and that is what is the matter with philosophy.
(Lichtenberg 1908:78)[2]

Perhaps this is also what the father of chemistry, Antoine Laurent Lavoisier, meant when he observed in his *Traité Élémentaire de Chimie:*

> It is impossible to disassociate language from science or science from language, because every natural science always involves three things:
>
> the sequence of phenomena on which the science is based;
> the abstract concepts which call these phenomena to mind;
> and the words in which the concepts are expressed.

> To call forth a concept a word is needed; to portray a phenomenon a concept is needed. All three mirror one and the same reality. (Lavoisier 1789:¶3)

And yet there are those in our field who suppose linguistics must become a subclass of philosophy, when it is the reverse that is so obviously true.

Translation is frequently less than perfectly possible, not merely in the domain of high poetic visions but even in translating from one allegedly precise technical vocabulary to another. Remarkably few translations can be totally faithful to their originals, just as remarkably few paraphrases within a single language can be completely faithful to the text being paraphrased. Conscientious technical translators are continually adding footnotes, introductions, and technical addenda to their work or may even request to discuss the meaning of the text with the authors or editors of the original. Those who continue to spread the misconception of perfect translation have obviously never bothered to consult with a translator or translation editor. In the words of Miguel de Unamuno:

> An idea does not pass from one language to another without change.
> (Unamuno 1954:xxxiii.)

Unamuno might have been equally correct if he had added that ideas have frequently been known to change shape when transmitted even within a single language.

2. THREE MAJOR ERRORS BY LINGUISTS. This part of the present study may be conveniently summarized in three major errors made by professional linguists over at least the past five decades:

(1) Linguists have attempted to reify language, to turn it into a thing, an object of study, when it is in fact a complex process that develops within each of us over time with a slightly different learning curve for each individual. And language is not just any process but the primary process through which almost all knowledge, including knowledge of its own workings, can be gained.

(2) They have attempted to impose the erroneous assumption that language is generic, homogenized, even universal, when language in fact varies from people to people and culture to culture and even within a single people or culture and can far better be described as *sui generis*, multifaceted, rooted in particular circumstances and limited contexts.

(3) They have tried to impose the even more dubious proposition that human cognition is generic, united, relatively unvarying between and among individuals, or at the very least subject to a bell-shaped curve with a predictable range of variations. But the growing evidence about cognition favors a markedly different outlook. The recent discovery of the Asperger's/Autism Spectrum, along with accumulating evidence that a comparable Bipolar Spectrum may also exist, suggests that the totality of human cognition may not fit neatly into a bell-shaped curve at all but occupies a far broader spectrum of conditions. This includes even so-called normal

> cognition. If true, this could well transform the results of much recent research into so-called cognitive branches of learning. It also may mean that the 350 million dollars granted to MIT a few years ago by the McGovern Foundation for research into neurolinguistics could end up being wasted.

3. EVIDENCE BASED MEDICINE AND EVIDENCE BASED LINGUISTICS. But it's time to address Evidence Based Medicine (EBM) and whether it can serve as a model for building a truly Evidence Based Linguistics. You may already know that Evidence Based Medicine, while not perfect, is the runaway success story in today's medical arena. And since linguistics may perhaps most appropriately be seen as a branch of human physiology, and hence subject to similar conditions and restrictions, this means that if we could evolve a comparable version of Evidence Based Linguistics, we might indeed have prepared the groundwork for some real advances in our field. But before we reach out for any such conclusion, let's make sure we have some understanding of what Evidence Based Medicine is all about.

There can be no doubt that EBM is the major medical paradigm of the last few decades. Although it began in England in 1972 with the work of Doctor Archie Cochrane, its major impact in this country has been during the last ten years. If you go to amazon.com, you'll find that some 325 books about EBM are listed, almost all of them published since 1995. If on the other hand you go to NYU's Bobst Library, which is attached to a major medical teaching college, you'll find that they have collected only some eighty of these volumes, about a quarter of the total. This is a fairly respectable percentage, especially when compared to linguistics.

Parenthetically, it is useful to understand what these figures truly reveal. About fifteen years ago university librarians publicly announced that they could no longer go on collecting the many repetitious, ponderously terminological, self-serving volumes that were being published as a form of career advancement in several of the social sciences, psychology, sociology, and linguistics among them. For instance, if you go to amazon and search out books under the heading 'constraints linguistics', you'll find 94 volumes listed. But if you go to either the NYU Bobst or the New York Public Library, you'll discover that they have each collected only two or three of these, which may in fact be a wise policy decision.

That's why 80 out of 325 books on EBM is actually a rather good score, and all criticisms aside, there is no doubt that EBM is the wave of the future in most medical fields, although it too has critics. They make the point that EBM methods have sometimes been used to short-change patients in the medical care they receive. It's also probable that recent reports that quite a few well-known medications and therapies are less effective than previously believed may spring from EBM-based research projects, leaving it somewhat problematic, despite the excellence of the theory, as to whether we truly know enough in all cases to set up valid testing procedures for this new approach. But the question remains as to how something like EBM can be best applied to the study of linguistics.

This question could quickly convert our topic into a highly technical medical discussion, so this section may best be limited to a consideration of EBM as presented by wikipedia.org and the Centre for Evidence Based Medicine. On that basis we then consider

how EBM principles might best be converted into a set of guidelines for Evidence Based Linguistics.

3.1. A SUMMARY OF EBM. The following extended quotation is how wikipedia and the Centre for EBM sum up this field:

> Evidence-based medicine is a medical movement based upon the application of the scientific method to medical practice, including long-established existing medical traditions not yet subjected to adequate scientific scrutiny. According to the Centre for Evidence-Based Medicine, 'Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients.'
>
> **Overview**
> Using techniques from science, engineering and statistics, such as meta-analysis of the existing literature, risk-benefit analysis and randomized controlled trials, it aims for the ideal that all doctors should make 'conscientious, explicit, and judicious use of current best evidence' in making decisions about the care of individual patients.
>
> Evidence-based medicine holds that testimonials, hearsay and mystical arguments have little value as proof because the placebo effect, random events and observer bias distort perceptions.
>
> Practicing evidence-based medicine implies not only clinical expertise, but expertise in retrieving, interpreting, and applying the results of scientific studies, and in communicating the risks and benefit of different courses of action to patients.
>
> For all its problems, evidence-based medicine has very successfully demoted the ex cathedra statement of the 'medical expert' to the least valid form of evidence and all 'experts' are now expected to be able to reference their pronouncements to the relevant literature. (wikipedia.org & Centre for EBM)

3.2. BACKGROUND TO EVIDENCE BASED LINGUISTICS. Based on these criteria for EBM, I now propose to derive a set of comparable Guidelines for Evidence Based Linguistics, springing from a set of questions about linguistics today and their probable answers. Here are those questions:

- Is scientific observation truly being applied in our field? Here the only answer is clearly No.
- Have aesthetic considerations been imposed over thoughtful investigation? Here the answer is clearly Yes.

- Have the opinions of alleged 'experts' been favored over careful investigation and the testing of hypotheses? Yes, in so-called mainstream linguistics this is indeed the case.
- Precisely how qualified have the 'experts' been in dealing with multiple aspects of language? The answer here would be 'not very qualified at all'.
- Have mentalistic, formalistic criteria taken precedence over physiological realities? The answer here is an emphatic yes.
- Are the views of alleged authorities—even ancient authorities long abandoned by other sciences—held to be more important than actual observation of how language works? Once again, clearly yes.
- Have data and other sources of information been actively solicited from all groups working professionally within the language field? No, not to any meaningful extent.
- Have specific inputs or types of information or data been explicitly excluded? Yes again. Only a few of these excluded resources can be mentioned.

3.3. GUIDELINES FOR EVIDENCE BASED LINGUISTICS. The guidelines spring from the above questions and the answers they evoke. Certain conclusions spring from these questions and answers. We list them in order.

1. In all our work we must make sure that scientific observation is being followed as rigorously as possible.
2. We must take great care to ensure that esthetic preferences do not take precedence over scientific conclusions based on genuine observation.
3. We would do best to favor measurable physiological data, where it is available, over formalistic, mentalistic suppositions.
4. We must make sure that no relevant information is excluded from our investigations, even if it comes from hitherto untapped sources.
5. Towards this aim we need to seek out the input of professional language users, translators, interpreters, bilingual editors, writers, and language teachers among them, even if their testimony goes against previously accepted conventional wisdom.
6. Above all, we must carefully weigh the views of all experts and authorities in our field, whether ancient or modern, and be prepared to reject their views if they do not satisfy the conditions of science.

Some further observations are in order about how to apply these principles in practice, especially concerning how to detect the differences between esthetic preferences and scientific conclusions, but we leave these for now and turn to a short introduction of the directions linguistics should take.

4. POSSIBLE DIRECTIONS FOR LINGUISTICS. A summation of the possible directions is as follows. One important insight into linguistics springing from translation studies is discussed in Gross (2003:86–91). This paper describes a *Gedankenexperiment* demonstrating

that there is essentially no difference between the problems of translating from one language to another and those involved in paraphrasing the text of a single one. The description itself presents credible evidence proving the truth of the paper's thesis. To the extent that these results are correct, there is no way that we as scientists can discuss language unless we are also willing to discuss translation, and vice versa.

Moreover, a dialogue between translators and linguists could be helpful for another reason as well: experts in many of the sciences often seem to believe that they are always unconditionally right in their opinions. Translators, by contrast, dwell in a realm where they continually believe they may be mistaken. It would seem reasonable that the latter attitude is the more appropriate one for linguistics. Georges Mounin (whose reputation and prolific output made him the French equivalent of David Crystal) observed that there can be no valid theory of linguistics that does not also provide a workable theory of translation, and since Mounin is the only linguist who has written both a history of linguistics and one of translation, his work ought to better known among Anglophone linguists (Mounin 1990:69–74).

Another useful aspect of linguistics embraces a form of differential diagnosis that can be used to identify and distinguish between a far wider range of common language processes and disorders than the field has thus far recognized. This area includes measuring units for language as well as its relationship to cartography and the nature of fractal linguistics.

It should also be emphasized that while much of this material springs from the author's work in progress, it embraces work by others that bases its findings in human physiology and demonstrable workings of the mind. In other words, the system being described is not a reductionist, exclusionary one but an expandable one. There is plenty of room, say, for Lamb's Neurocognitive Linguistics (Lamb 1999 *passim*, cf. online at *http://www.ruf.rice.edu/~lngbrain/*) as well as a theory being developed by Price Caldwell (2005:*passim*).

5. LINGUISTICS AND PHYSIOLOGY. We now turn to the physiological side of language. Rather than searching for metalinguistic principles, we view language on its most basic level as primarily a physiological, even a bodily function.

One could be a bit poetic here, but also a bit evasive, by stating that language is the musical instrument that uses the air from the lungs to project the sounds of the larynx as modified by the keyboard of the uvula, palate, tongue, and lips. One could go further and become a bit coarser by adding that language is a lot closer to the sounds of belching and burping from the stomach and gasping and wheezing from the lungs than it is to Aristotelian logic, Boolean logic, or synthetic syntactic restructuring. But that still may not be coarse enough to convey the full physiological aspect of language.

There remains a need to explain quite clearly what is meant by calling language a bodily function. Not just human beings, not just animals, but even plants as well—in other words, all of life itself—relies on just one clever trick to maintain itself: the exchange of gases and fluids, sometimes with the odd bit of so-called solid matter thrown in. This is true of breathing in and out, of ingestion and excretion, even of the exchange of sexual fluids. If we start from this primitive level and work our way forward from there, not only will we be able to

see how language fits into this process, but we may also gain some unexpected insights into the field of evolutionary linguistics, a rapidly expanding growth industry among us that has encouraged specialists from many fields but almost no professional language users to hold forth on a great variety of theories. The rule encapsulated by a German proverb still holds true: *Jeder Mensch glaubt, weil er spricht, über die Sprache sprechen zu dürfen* – 'Every human being believes that because he speaks he is also entitled to speak about language'.

One step upward from the stage of merely exchanging gases and fluids between organisms is to add a distinctive chemical that other organisms of the same type recognize while at the same time repelling certain different organisms. Already a form of message is being conveyed. One step beyond that is to employ a chemical that other life forms can recognize to attract or antagonize them. The message has become a bit more complex. The next step, well-known among biologists, is to make this exchange more noticeable by adding a chemical aroma. This process is known as scent marking. A parallel step, taken by many species including our own, is to add what may quite legitimately be called sound markings.

There are in fact five separate pieces on my website describing the relationship between scent markings and sound markings (Gross 1993a, 1993b, 1995/96, 2000a, 2000b). It is not unreasonable to claim that in a very real sense all of human language is nothing more or less than a highly elaborated form of sound markings. Where other animals spray the scent markings on their environment, we spray sound markings on or in the direction of almost everything around us. Sound markings are constantly sprayed at us, and we have chances to spray our own back. Moreover, all of us carry out this process just as insistently as any pussy cat hard at work marking our carpets, our armchairs, and our trouser legs as its own.

From at least one aspect, human language can be viewed as merely an advanced form of spray. If we have failed to notice this before now, one reason ought to be fairly obvious: our abiding cultural reluctance bequeathed to us by Puritanism cum Victorianism to look at how our bodies really work. Or perhaps it's merely squeamishness. But there is very little useful to be learned about many topics related to medicine or human physiology without finally abandoning almost every vestige of squeamishness. This topic has been treated in a semi-humorous manner in the sequence 'Spray It Again, Sam', available on my website as part of the program entitled 'Truth About Translation'.

Just as marine life has been observed repeating evolutionary phases in the seas around us, so we can observe various life forms continually recapitulating various forms of communication around us. What further evidence do we need that human language and sound markings come close to being synonymous? Can anyone state with absolute certainty that what we do with our sound markings is all that different from what sea lions do with their barks, crickets with their chirps, or bees with their dances? (Though bees are also known to employ scent markings to convey their messages.) At some point, possibly among higher primates, an evolutionary step was clearly taken to favor sound markings and gradually phase out scent markings. Jane Goodall (personal communication) has observed that even chimpanzees rarely use odor as a major form of communication, though male chimps give off a strong scent at mating time. This could also provide an explanation for the near simultaneous surging of our language skills along with the gradual atrophy of our sense of smell as compared with other animals.

If this finding holds up for other hominid apes, it means that both humans and their closest relatives began to give up scent markings at a fairly early stage in their evolution. This would mean that the period when higher primates began to lose the vast animal sensorium of aromas coincided with the period when humans first began to develop language. But vast numbers of other animals still use scent markings, and the precise evolutionary events involved, assuming they occurred as described, are of course still unknown. For instance, Frans de Waal has recorded instances of Bonobo chimps recognizing each other through their scent after long absences (Dreifus 2001).

While some may find such a connection unseemly, there is good reason for insisting on these links between scent markings and sound markings. They form part of the common thread in an exchange of gases and fluids through a whole phylogeny of plant and animal species and as such unavoidably furnish the basic substance of all human communication, the carrier wave so to speak. I have been told that the following point is so obvious that it perhaps should be omitted altogether, but it may still need spelling out. This is after all a presentation about evidence. If anyone requires compelling evidence for the gaseous content of language, let them simply hold their hand in front of their mouths while they speak. If they need evidence for the fluid content of language, let them keep that hand in place a bit longer, say for about two minutes, while they count in a whisper from 1 to 200, after which they will discover a small damp patch in the very center of the palms of their hands. Quod erat demonstrandum. On its most basic level language is composed of gas and fluids.... while sometimes communicating thought.

The recognition of language as a physical process on its most basic level may also open the door to the recognition that language in itself, like all other physical processes, may be subject to various irregularities in growth and development, even various pathological conditions not normally studied under language handicaps.

Here a further disclaimer is probably in order, since such recognition necessarily also opens the door to a number of topics not currently covered under linguistics. It is certainly not the goal of this presentation to debase human speech to nothing more than animal sprayings or to suggest that language does not also possess other more abstract properties. But would such an evolution not explain much about how human beings still use language today? Moreover, as I has written elsewhere (Gross 1993a), would not such an evolution also aptly explain the attitudes of many 'literal-minded' people, who insist on a single interpretation of specific words, even when it is carefully explained to them that this is mistaken? Does it not suggest at least one possible reason why many misunderstandings fester into outright conflicts, even physical confrontations? Assuming the roots of language lie at least partially in territoriality, would this not also go some distance towards clarifying some of the causes of border disputes, even of wars? Perhaps most important of all, does such a development not provide a physiological basis for some of the differences between languages, which themselves have become secondary causes in separating peoples? Would it not also permit us to see different languages as exclusive and proprietary techniques of spraying, according to different nozzle apertures, colors, or viscosity? Could it conceivably shed some light on the fanaticism of various forms of religious, political, or social fundamentalisms? Might it even explain the bitterness of some scholarly feuding?

6. LINGUISTICS AND EVOLUTION. Perhaps most important, at a time when the majority of Americans has apparently decided that evolution is no more than a theory, does this discovery that human language is clearly allied to animal scent markings not present important new evidence that evolution must in fact be true? In addition to offending today's puritan attitudes, does it not at least for some evoke much the same sense of shock that our ancestors felt a century ago when told that humans might have at least something in common with monkeys? It was the hope of linguists like Whorf, Sapir and the younger Hayakawa that our field of study could provide a continual flow of insights for our citizens about the values we live by. Would it not make a great deal more sense if leaders of our profession, instead of wasting their time on warmed-over cold war causes, were sharing this important truth about evolution with the general public?

Even before today a few of you have taken pains to inform me that this truth is simply too obvious to bear such repeated emphasis as has been given here. Yet it may be worth while considering whether such criticism may not be prompted by a barely concealed form of theism holding that we as humans can occupy only a sublimely elevated station just one degree below the angels, and that our form of communication must also be equally exalted in character. But there is no real evidence for this view, and the absence of such evidence prompts one to wonder if the seemingly perpetual debate carried on since 1984 first by the Language Origins Society and now by Evolang may be a prolonged attempt to avoid the obvious connection between language and evolution, simply that human language is evolution in action, through its transformation from scent markings to sound markings.

If language forms the basis of all our sciences and is in fact inextricably connected to natural evolution, then we might expect a number of new directions to open in our field. But I doubt if those directions can emerge from ever more rigorous logic-chopping and sentence-diagramming, rather its origins are more likely to lie in the many new insights we may gain by leaving logic, mathematics, and philosophy behind and returning language to its birthplace as a branch of human physiology. In other words, we can turn linguistics into a hard*er* science, but never a fully hard one, or at least no harder than physiology and biology themselves. This is where language ultimately belongs, and not in all those other domains of knowledge where so many in our field are trying to enshrine it. In the totality of its diachronic and social development, language may also belong under the general heading of natural history. I once tried to design a museum exhibit about translation for a natural history museum (see Gross 1994 for parts of it), and it would probably be feasible to design an appropriate natural history exhibit for language and linguistics as well.

7. CONCLUSIONS. Perhaps the main point all along has been how extraordinarily complex and multi-faceted language truly is, and how remarkably far its overall territory stretches beyond any simplistic, allegedly unified, or speciously universal doctrine. One further way of expressing this idea lies in a slightly adapted version of a famous nineteenth century American poem, which you may have encountered before. Only four words needed to be changed to make it fit rather aptly into today's world of linguistics. Here is that poem:

The Blind Linguists and the Elephant
Six gurus wise of Linguastan
To learning much inclined,
Went forth to see the Elephant~
(Though all of them were blind),
That each by observation
Might satisfy his mind.

The First approached the Elephant,
And happening to fall
Against his broad and sturdy side,
At once began to bawl:
'God bless me! but the Elephant
Is very like a wall!'

The Second, feeling of the tusk,
Cried, 'Ho! what have we here?
So very round and smooth and sharp?
To me 'tis mighty clear
This wonder of an Elephant
Is very like a spear!'

The Third approached the animal,
And happening to take
The squirming trunk within his hands,
Thus boldly up and spake:
'I see', quoth he, 'the Elephant
Is very like a snake!'

The Fourth reached out an eager hand,
And felt about the knee.
'What most this wondrous beast is like
Is mighty plain', quoth he;
' 'Tis clear enough the Elephant
Is very like a tree!'

The Fifth who chanced to touch the ear,
Said: 'E'en the blindest man
Can tell what this resembles most;
Deny the fact who can,
This marvel of an Elephant
Is very like a fan!"

The Sixth no sooner had begun
About the beast to grope,
Than, seizing on the swinging tail
That fell within his scope,
'I see', quoth he, 'the Elephant
Is very like a rope!'

These hoary seers of Linguastan
Disputed loud and long,
Each in his own opinion
Exceeding stiff and strong,
Though each was partly in the right
And all were in the wrong!

Envoi:
So oft in wild linguistics wars,
Most disputants we have seen,
Rail on in utter ignorance
Of what each other mean,
And prate about an Elephant
Not one of them has seen!

This version is close to the text by the American poet John Godfrey Saxe, which was itself based on a Han Dynasty poem in Chinese. A century ago it was believed that these verses shed light on the various claims of conflicting religious faiths. But it requires only a slight adaptation for the poem to work equally well for linguistics.

In this first session it has only been possible to suggest how many sides to the elephant there might be. There has probably been an undue concentration on the bodily fluids of the elephant as an exercise in physiology. We have not touched on a number of other aspects, e.g. the elephant's skin surface as seen through cartography, the differential diagnosis of the elephant in health and disease, the various fractal extensions of the animal, what elephants look like in other languages, and what I like to call the Six Laws of Language and Linguistics in Draft Form, the basic laws that keep the elephant going. One aspect I do not address is the syntactic structure of the elephant, simply because syntactic structure is almost totally useless in understanding either elephants or languages.

One question of course provokes a certain curiosity: is there any hope that such complexity can ever be integrated into existing departments of linguistics at our universities? It may well border on the unlikely that this can ever come about, at least not without substantial reorganization of the university. More to the point, one delightful citation, which has been attributed to Freud but is more likely to be an urban folk saying among college administrators, makes the following observation:

> Reorganizing the university is like rearranging the graves in a cemetery.[3]

In any case, scientific investigation cannot be compelled to wait for such a reorganization to happen. My subsequent research topic is "Practical Linguistics for Translators (and for the General Public)" some time later this year or early next year. So however many schools of linguistics we may now have, this just might be a new one.

A generation ago or two, the back cover of *The American Scholar* always featured Ralph Waldo Emerson's five-word definition 'The Scholar Is Man Thinking'. Today he might have said 'The Scholar Is Humanity Thinking'; in other words, the scholar is someone thinking for and on behalf of all humanity. Today it seems that the Scholar is interested in communicating with other Scholars for the purpose of advancing his own theories or discussing similar theories of little interest outside the profession and in enhancing her own status within that profession.

This could conceivably change. But there is little room for being sanguine. The pressure from the weight of false ideas blocking such a change, in linguistics and in other areas, was perhaps best summed up almost two thousand years ago by the neo-Platonist philosopher Epictetus:

Ταράσσει τοὺς ἀνθρώπους οὐ τὰ πράγματα,
ἀλλὰ τὰ περὶ τῶν πραγμάτων δόγματα·.
[Tarassei tous anthrōpous ou ta pragmata,
alla ta peri tōn pragmatōn dogmata.]
(Epictetus V vol ii: 487)

Or roughly:

Real things don't cause people trouble,
Only ideas about real things.

The only factor that opens the way to even guarded optimism is an eight-character verse by Lao Tse, composed some six hundred years earlier than the works of Epictetus:

信言不美，美言不信。
[xìn yán bù měi, měi yán bù xìn.]

Although this work has been translated several hundred times, the version that makes the most sense in our current context is the following:

Real words are not vain,
Vain words are not real.
(Lao Tse c. 600 BCE:81)[4]

With luck these have not been vain words.

[1] Original text appears to be Florio's English.

[2] This citation was first found in a dictionary of quotations and was evidently revised from the 1908 translated version, which read: 'Language originated prior to philosophy, and that is what handicaps philosophy…'

[3] Two possible sources for this citation are:
http://www.highereducation.org/crosstalk/ct1097/news1097-merger.shtml, and
http://www.usask.ca/library/gic/v1n2/macdonald/macdonald.html

[4] The author is fairly sure this was a translation by Ezra Pound he encountered some five decades ago, like many other classical Chinese passages included in one or another version of his labyrinthine *Cantos*, even though he has not yet been able to locate it there. This was a late 1940s edition of a work that later went through many corrections, changes and new editions. It stands as a memorable phrase in its own right, even though a more accurate translation might read, 'sincere words are not beautiful, beautiful words are not sincere'.

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A COMPUTERIZED, LEVEL-BY-LEVEL MODEL OF TRANSDUCTION

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The theme of our meeting this year is networks, and one kind of a network is one that will let us model the transductions of utterances as they pass downward or upward through language. During the past few years, I have been using a linguistic network model which should potentially be able to describe the traces[1] of texts[2] as they are transduced through it, all the way from their semologies to their phonologies or graphonomies and vice versa. I have already published pieces of this model (Herrick 1986, 1993, 2000), but I have never clearly stated its assumptions. What I want to do here is to systematically present the assumptions made by this model and also to show how to use it for representing linguistic texts on a computer, with the hope that others can use it more readily.

In order to represent how the trace of a text is transduced through a language, this model makes three assumptions.

(1) It is not enough simply to speak of the trace of a text. A trace is made up of many strands, and it is necessary to follow each strand of the trace through the transduction.
(2) The transduction of the trace in a text can be modeled by a step-by-step process, in which all the strands of the trace are first completely described on one level of language and are then completely described on its successively adjacent levels, one after another.
(3) Within every alternation or sign pattern, the relationships among all the strands of its trace, as they are transduced through that pattern, must be specifically described.

The effects of these assumptions are the following:

(1) We must pay individual attention to each of the strands that make up the trace of a text.
(2) We can model the transduction of a text by a step-by-step process, in which we specify all the strands that constitute the trace of that text on one level (whatever level may be chosen); and we then realize each of those strands (in whatever way it is realized according to the patterns of its language) on the nearest adjacent level; and so on successively, level by level, until all of the strands are described by whatever realizes them on the furthest level of its linguistic system.
(3) On every level of language, we must describe the relationships that exist among all the traces of a text as they pass through that level. It is not enough merely to show

d **q**

^{GS}/miniscule d/ ^{GS}/miniscule q/

Figure 1. *Two graphemic signs of shape used here as examples.*

the strands of a trace; it is also necessary to show the relationships among those strands.

This model uses a special notation for showing the relationships among the strands of a trace as it passes through a level of language. The usual stratificational method of showing internal relationships among the parts of a text has been to use ORDERED AND and UNORDERED AND nodes in the tactic patterns. The model described here adds two things to this:

(1) The usual stratificational model shows the internal organization of a text only on the levels of the strata, where the tactics connect to the realization. This model shows the relationships among the strands of a realization within every alternation and sign pattern.
(2) This model uses a special notation that directly shows the relationships among the strands in the trace of a realization.

I originally developed this special notation while working with graphonomy, because the data of graphonomy exists on a two-dimensional visible plane, and it therefore requires some notation for specifying where things are located relative to one another in two dimensions. An example of this problem is shown in **Figure 1**. The two letter-shape graphemic signs shown there, ^{GS}/minuscule d/ and ^{GS}/minuscule q/, are described by the same graphons (i.e. the same contrastive features) of shape, but the parts of those letter-shapes are arranged in different ways. Both marks have vertical, straight appendages extending from the right sides of their loops. But for ^{GS}/minuscule d/, the straight appendage extends upward, and for ^{GS}/minuscule q/, it extends downward. I have found it easiest to describe the location of this appendage according to the diagonal of the loop on which it is located, so I refer to the upper-left-to-lower-right diagonal as the *major diagonal* and to the upper-right-to-lower-left diagonal as the *minor diagonal*.

Two varieties of the notational device that I have used for describing these locations are shown in **Figures 2** and **3**. *Intra-level trace organization indicator*, the term I use for them, is unfortunately long and jargony, but it says exactly what this notational device does, and it can be abbreviated as *ILTOI*, pronounced 'ill-toy'.

Figure 2 shows (in complete form on the left and in abbreviated form on the right) one variety of ILTOI that contains elements of two kinds. One of these kinds, which occurs exactly once in each ILTOI, is written between slant lines with superscript A and is called ARACHNE, from the Greek word for spider, because the whole ILTOI looks rather like a spider. The term written between the arachne's slant lines names the relationship that exists among some strands of a trace. The other kind of element, which can occur two or more

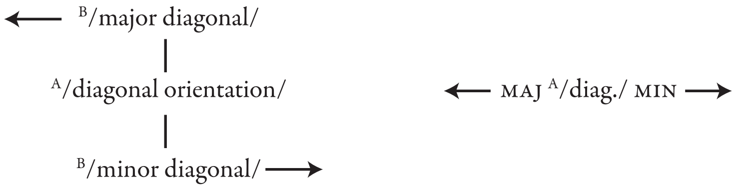

Figure 2. *Intra-level trace organization indicator with two kinds of elements.*

Figure 3. *Intra-level trace organization indicator with only one kind of element.*

times in each ILTOI, is written between slant lines with superscript B and is called BRACHION, from the Greek word for arm. The term written between each brachion's slant lines names one of the alternatives or poles of the relationship named by the arachne, and arrows run from each brachion to the strands of the trace that are related in the way shown by the ILTOI. In the example in **Figure 2**, the arachne says that the relationship among the strands of the transduction is DIAGONAL ORIENTATION, and its two brachions have arrows that point to the strands that state what shapes appear along the major and minor diagonals.

Another variety of ILTOI, shown in **Figure 3** (in complete form on the left and in abbreviated form on the right), contains only one kind of element and states that two or more strands of a transduction all share a certain relationship. The term written in the arachne names the relationship shared by the strands, there are no brachions specified, and arrows point to all the strands that are related in that way. In the example, the arachne says that the strands share the relationship SIMULTANEOUS.

Although I met this problem while studying graphonomy, I believe that something like this notation is needed for many parts of language. Description of the internal structure of a text by using only ORDERED AND and UNORDERED AND nodes in the tactics may suffice for morphology, which is the most interior part of language, and it may also suffice for phonology. But lexology and semology are so complicated that they will have to have their internal structures shown by some notation such as ILTOIs.[3]

Any paper that discusses a stratificational transduction is in danger of getting horribly complicated,[4] and this paper therefore simply uses as its example the single printed character shown in **Figure 1** which embodies the letter grapheme ^{G}/D/ and is realized through the stratificational network shown in **Figure 4** (overleaf).

Figure 4 includes an ILTOI showing the relative location of two parts of the shape of ^{G}/D/, another ILTOI showing that the entire diagram describes the same character, and two ILTOIs showing the location of this character within a text. The three levels at which slices will be taken through this trace are also shown.

The network in **Figure 4** shows that this grapheme, in the absence of any reason why it should be capitalized, is realized by the graphemic sign of shape ^{GS}/minuscule d/ and by

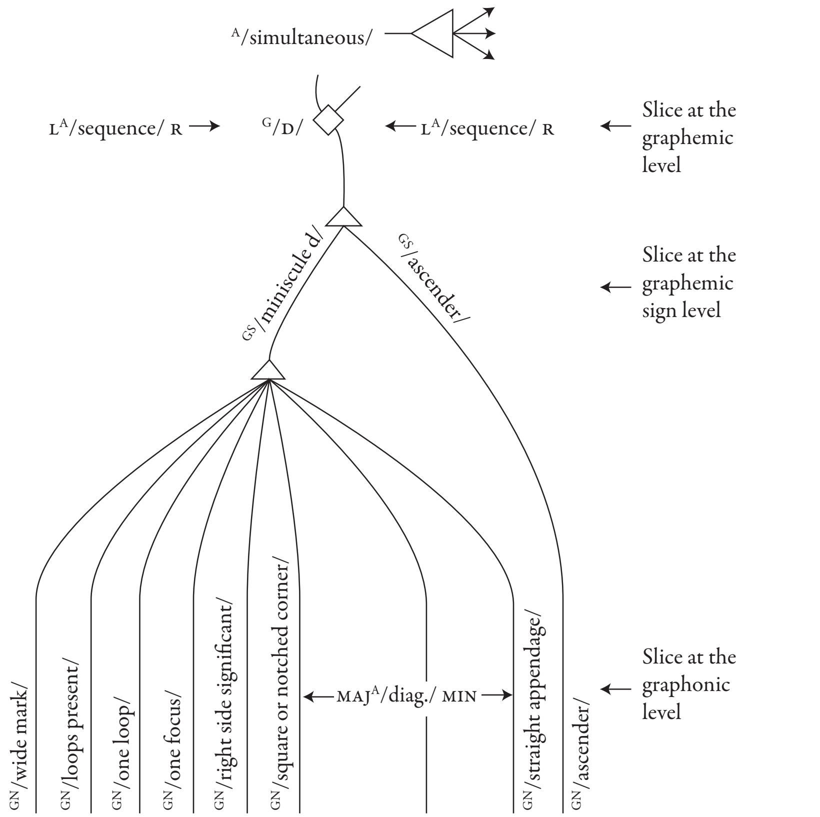

Figure 4. *A trace of the realization of non-capitalized ^{G}/D/.*

the graphemic sign of height ^{GS}/ascender/. It also shows that ^{GS}/minuscule d/ is realized, through the lower of the downward AND nodes, by seven graphons of shape that state facts about the mark's shape and shows that ^{GS}/ascender/ is trivially realized by ^{GN}/ascender/.[5]

Moreover, **Figure 4** also shows that ^{GS}/minuscule d/ is realized by an ILTOI that has the arachne ^{A}/diag./ (for diagonal orientation) and two brachions with the abbreviations 'MAJ' and 'MIN' and with arrows pointing to the graphons that describe the mark's shape along its major and minor diagonals.[6] Floating above the entire diagram in **Figure 4**, the arachne ^{A}/simultaneous/ shows that everything in the realization of ^{GS}/D/ is simultaneous with everything else in it. And to the left and right of the diagram, there are two occurrences of the arachne ^{A}/sequence/ with abbreviated brachions for RIGHT and LEFT, which remind us that ^{G}/D/ is part of a text that consists, on the graphemic level, of a long string of graphemes strung together in sequence.[7] Except for the ILTOIs, **Figure 4** is a stratificational diagram of a familiar sort.

The step-by-step process that I have used for modeling stratificational transduction on a computer operates by taking horizontal slices through the alternation and sign patterns in

***Figure 5.** Description of the slice taken at the graphemic level.*

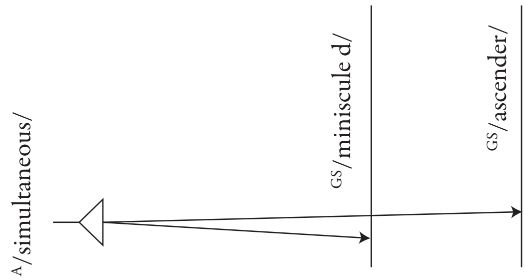

***Figure 6.** Description of the slice taken at the graphemic-sign level.*

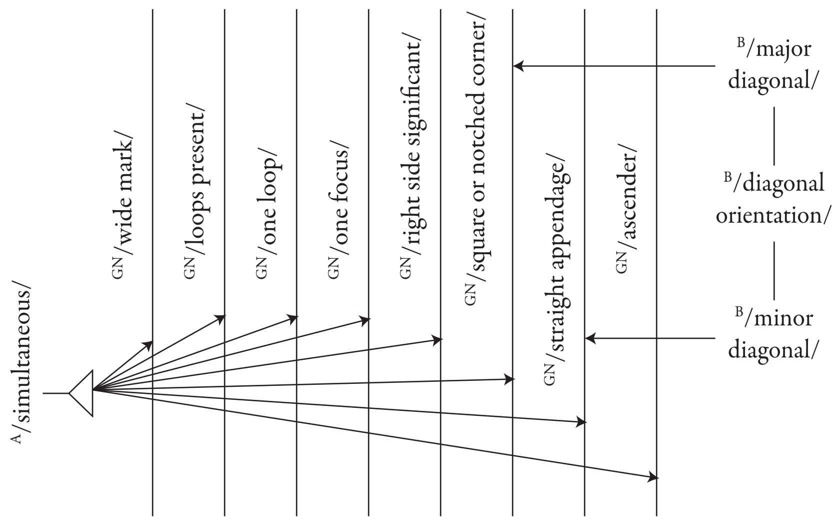

***Figure 7.** Description of the slice taken at the graphonic level.*

the diagram in **Figure 4**, so that the text will be described first in terms of graphemes, then in terms of graphemic signs, and then in terms of graphons. The resulting descriptions in terms of these three levels are shown in **Figures 5–7**.

Slicing across the diagram in **Figure 4** at the graphemic level, we encounter only ^{G}/D/,[8] as shown in **Figure 5**. Slicing across it at the graphemic-sign level, as shown in **Figure 6**,

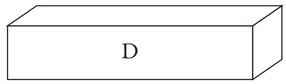

Figure 8. *Model on the graphemic level.*

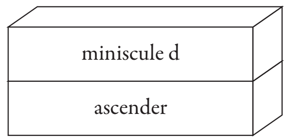

Figure 9. *Model on the graphemic level.*

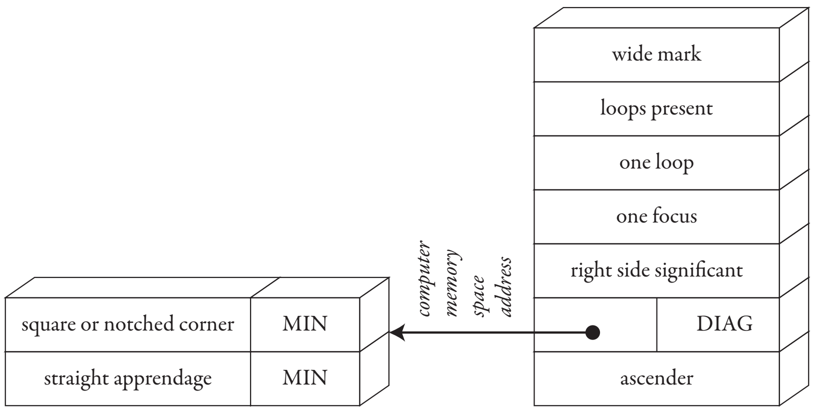

Figure 10. *Model on the graphemic level.*

we encounter the two graphemic signs ^{GS}/minuscule d/ and ^{GS}/ascender/ and the ILTOI which states that they occur simultaneously. Slicing acrosss it at the graphonic level, we encounter, as shown in **Figure 7**, seven graphons that realize ^{GS}/minuscule d/, one graphon that realizes ^{GS}/ascender/, and the ILTOI stating that they all occur simultaneously. We also encounter an ILTOI stating which graphon describes the mark along each of its two diagonals. (An appendix to this paper lists all of the graphons that realize ^{GS}/minuscule d/, along with other graphons that contrast with each of them and with letter-shapes that are realized by those contrasting graphons.)

Figures 5, **6**, and **7** therefore show three related but different descriptions of this one-letter text, and an automated process for getting successively from one of these descriptions to another could be used for modeling the transduction of a text through its language. **Figures 8**, **9**, and **10** show how this can be done on a computer. The notation used in these three figures, while it may be unfamiliar to many linguists, conveys exactly the same information as is conveyed in **Figures 5**, **6**, and **7**, and it is one that is commonly used in teaching computer programming. Each box in these figures represents a space in a computer's memory, and each box has an address and contents. (Just where those boxes are located in the

computer's memory does not concern us; the computer programming language assigns their addresses and keeps track of them. In writing a computer program to model this transduction, we simply declare that there will be an arrangement of boxes, called an *array* by computer programmers, with one or more dimensions.) What the computer program must do is put some things into certain boxes, and then go through those boxes and look at those things, and then do something on the basis of what it finds there, such as putting something else into certain other boxes in another array.[9]

This example assumes that we are running a computer program for modeling transduction. It also assumes that this program has, defined in it, an array of boxes that will represent some text on its graphemic level, and it assumes that one of its boxes contains the grapheme ^{G}/D/. The program begins by calling a subprogram which first creates an array of empty boxes that will represent the same text in terms of graphemic signs. This subprogram then goes through the graphemic array, looks at each grapheme one by one, decides how that grapheme is to be realized on the graphemic-sign level and writes that realization in terms of graphemic signs into the new graphemic-sign array.

In the example in **Figure 8**, therefore, the grapheme-to-graphemic-sign subprogram will look into the box in the graphemic array and will find grapheme ^{G}/D/. It will have programmed into it the knowledge that ^{G}/D/, in the absence of any reason to capitalize it, is realized by ^{GS}/minuscule d/ and ^{GS}/ascender/, and it will write those two graphemic signs into the new, graphemic-sign array. In **Figure 8**, the two boxes containing ^{GS}/minuscule d/ and ^{GS}/ascender/ are stacked one above the other, showing that the computer programming language has assigned to those boxes addresses that differ in only one dimension, and thereby showing that these two graphemic signs occur simultaneously.

When the entire text has been represented in the graphemic-sign array in terms of graphemic signs, the transduction program turns off its subprogram for grapheme-to-graphemic-sign transduction and turns on its subprogram for graphemic-sign-to-graphon transduction. This subprogram first creates an new, empty array to hold the definition of the text in terms of graphons, and it then goes through the entire graphemic-sign array, looks at each graphemic sign in each box, decides how each item is to be realized in terms of graphons, and writes those graphons into the graphonic array.

In this example, the graphemic-sign-to-graphon subprogram looks at ^{GS}/minuscule d/, decides that it is to be realized by seven graphons and one ILTOI, and writes the first five of those graphons, ^{GN}/wide mark/ through ^{GN}/right side significant/, into the new array that holds the description in terms of graphons. It also looks at the graphemic sign ^{GS}/ascender/ and writes ^{GN}/ascender/ into the graphonic array. (Once again, the boxes in this graphonic array are stacked one above another, thereby showing that they have been assigned addresses which show that they occur simultaneously.)

In order to model the ILTOI, its brachions, and the two graphons to which its brachions point, the graphemic-sign-to-graphon subprogram writes into the main graphon array the name of the arachne. It also creates, somewhere in the computer's memory, an additional array such as is shown to the left in **Figure 13** (overleaf), and it writes into the main graphon array the address of this additional array. (Just where this additional array is located does not matter; again the computer programming language keeps track of such things.) This

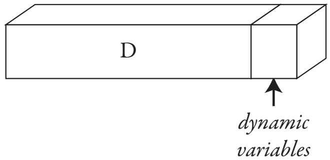

Figure 11. *Model on the graphemic level.*

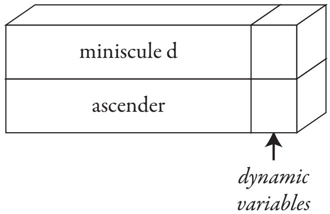

Figure 12. *Model on the graphemic-sign level.*

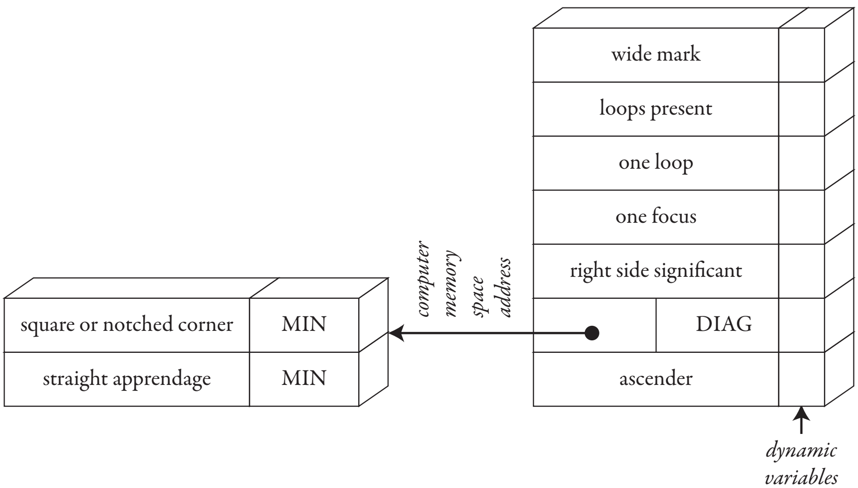

Figure 13. *Model on the graphonic level.*

additional array has two dimensions. In one of its columns, the subprogram stores the two graphons ^{GN}/square or notched corner/ and ^{GN}/straight appendage/ that describe the mark along its diagonals, and in the other column it stores the brachions that point to them, respectively. By looking at the contents of this additional array, one can therefore find out which brachion points to which graphon.

The model of language presented so far in this paper is a static one, and it cannot handle the kinds of dynamic phenomena discussed in Dell and Reich (1977) on slips of the tongue,[10] which involve activation that is both upward and downward, activation that spreads, and activation that fades. However, this model can be turned into a dynamic model by giving its arrays additional dimensions, i.e. additional rows or columns, as shown in **Figures 11, 12,**

and **13**, so that each of the boxes shown in **Figures 8**, **9**, and **10** has, next to it, one or more other boxes that can contain dynamic variables describing its item of the text. Additional computer programs can then be written that can go back and forth through all of these arrays on all of these levels to model dynamic changes. For example, one such program could simulate the spreading of activation from one box to another, while another such program could repeatedly run through the entire array and simulate fading by reducing certain values. Lots of things can be done by adroit programmers once the data is stored in arrays, although experiment will have to find out just how such processing takes place between levels and between strata.

The example of transduction described in this paper is quite short and is limited to graphonomy. However, its techniques of computerizing the modeling of transduction by first representing the trace of a text on one level and then having a computer program which embodies the realization rules of the language and which repeatedly goes through that representation step by step and rewrites each item by its realization on the next level may allow us to model parts of language other than graphonomy.

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1 The *trace* of a text is the path that it takes through the generalized model of its language (Lockwood 1972:42).

2 I follow Halliday's excellent usage of *text* to mean any product of a linguistic system, whatever the modality by which it is conveyed. As used here, it does not specifically mean a written document.

3 It would be interesting, for example, to see what happens when one tries to represent Fillmore's case grammar by using ILTOIs.

4 Hockett reportedly said that stratificational theory is great for people who want to publish their work by painting it on the sides of barns, and Oller, among others, reportedly said that that barn should belong to the Jolly Green Giant.

5 The occurrence of the two labels ^{GS}/ascender/ and ^{GN}/ascender/ on the single line in **Figure 4** is an artifact of this notation system. To make this model of realization work, it is important to have every line labeled on every level. Having two labels on this line is therefore no odder than driving along a state highway marked with one highway number and then crossing a state line and finding that the highway is marked with a different highway number. The same road in different jurisdictions may have different labels.

6 Just as an ILTOI can be part of a realization, it can be part of a realizate, and one ILTOI can be realized by another ILTOI.

7 The present paper barely introduces the idea of ILTOIs, but future research may find that they provide a general structure for the representation of a text as it is being transduced. If so, they would be compatible with Hjelmslev's idea that a linguistic system consists of nothing but relationships, including relationships between and among relationships.

Moreover, any ILTOI can be represented by the relative locations in a computer's memory where the labels of -emes, -emic signs, or -ons are stored, so long as the linguist is careful to keep a record of what the various relative locations mean. Thus, ^{A}/simultaneous/, which means that all of the things involved in the realization of ^{G}/D/ occur simultaneously, will be shown

by loading everything that describes the realization of ^{G}/D/ into the computer program's work space at the same time. And ^{A}/sequence/ and its brachions mean that ^{G}/D/occurs after some other grapheme and before yet another grapheme; to show this, the descriptions of ^{G}/D/ and of the graphemes that precede and follow it can be saved one after another in the correct order (either in the computer's memory or on tape) and read into the computer's work space in the appropriate sequence.

8 Because ^{G}/D/ occurs alone in this slice, ^{A}/simultaneous/ would be redundant, and whether that grapheme is shown with an ILTOI will depend on just how the computer program for modeling the transduction has been written.

9 Some stratificational descriptions are models of competence, i.e. models of what is possible within a certain language, not to be confused with Chomsky's idea of competence, and others are models of ideal performance, i.e. models of the traces of individual texts (Lockwood 1972:8–10). This computerization includes both kinds of modeling. The arrays recording the traces of a text on each level of the language constitute a model of ideal performance; the computer program that goes through each array and finds out how to represent its contents by a realization on an adjacent level is a model of competence.

10 I want to thank one of the anonymous reviewers of the abstract that I submitted for this paper for pointing this out to me.

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APPENDIX

The following table shows examples of $^{\text{GS}}$/miniscule d/ and the graphons that realize it, along with other graphons that contrast with those which realize $^{\text{GS}}$/miniscule d/ and examples of character shapes that those other graphons realize:

$^{\text{GN}}$/wide mark/	**d**	**l**	$^{\text{GN}}$/narrow mark/
$^{\text{GN}}$/loops present/	**d**	**n**	$^{\text{GN}}$/loops absent/
$^{\text{GN}}$/one loop/	**d**	**8**	$^{\text{GN}}$/two loops/
$^{\text{GN}}$/one focus/	**d**	**E**	$^{\text{GN}}$/two foci/
$^{\text{GN}}$/right side significant/	**d**	**A**	$^{\text{GN}}$/lower side significant/
$^{\text{GN}}$/square or notched corner/	**d**	**O**	$^{\text{GN}}$/rounded corner/
$^{\text{GN}}$/straight appendage/	**d**	**6**	$^{\text{GN}}$/curved appendage/
$^{\text{GN}}$/ascender/	**d**	**y**	$^{\text{GN}}$/descender/

BEING REALISTIC, BEING SCIENTIFIC

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THIS PAPER ARGUES IN FAVOR of being realistic and proposes that concern for reality will lead to a scientific linguistics.

It may be thought that linguists hardly need to be urged to be realistic, as they are already concerned with reality. But observation of common practice in linguistics reveals the contrary. Being concerned with reality requires paying attention to things that we have been accustomed to take for granted. Consider, for example, the common supposition that linguistics is the science of language. This statement depends upon the assumption that there are such things as languages. Is it a realistic assumption? I have argued elsewhere that it is not (Lamb 2004a). If it is not, this is an unrealistic belief. The concept LANGUAGE is at best a very abstract one. Language is several steps removed from reality (Lamb 2004a). You cannot touch, see, or feel a language. Yes, you can hear speech, but that is something different. Should we assume that because we have the word *language*, there must be such things as languages? *Language* is just a term of English. It may be interesting to take note of the fact that many 'languages' don't even have a term equivalent to the English term *language*.

Likewise, many linguists suppose that words, morphemes, lexemes have meanings. In what sense of *have* can this notion be viewed as realistic? Even more unrealistic is the commonly encountered belief that a given morpheme, for example a case ending, has a single core meaning, from which all others can be derived. The fact that exercises of deriving one meaning from another can be successfully conducted does not constitute evidence. As I have had students demonstrate in my cognitive linguistics class, it is possible to derive *any* meaning (of any word chosen at random) from any other meaning (of another word chosen at random by another student).

It seems that we can identify two major ways to avoid being realistic: (1) Accept words from ordinary language as valid technical terms (e.g. *language, word, meaning*); (2) Adopt assumptions without questioning them. Likewise, it seems that we can identify two simple principles for being realistic: (1) Start from concrete observable phenomena; (2) Observe.

Being realistic requires not only that we be suspicious of fashions and fads but also that we try to avoid talking metaphorically about linguistic matters. We cannot suppose that metaphors will provide realistic descriptions of phenomena. By definition a metaphor describes something as if it were something else that it is not. Michael Reddy (1979), in correctly challenging the conduit metaphor of communication, proposed that we consider, as an alternative, the tool-maker metaphor. But this is just another metaphor. Is it not possible to observe what really is the basis of our notions of meaning and communication, as a physical basis? The present paper argues that this question has a positive answer.

Concern for reality and careful observation will automatically render linguistic investigation more scientific. This, it can be argued, is the first basic principle of a scientific linguistics. The second, which follows from it, is that linguistics and its findings must be relatable to other sciences, including the physical sciences. If this requirement is followed, linguistics will be able to draw upon the findings of physical (including biological) science as well as to contribute to them.

I say above that we can't be realistic if we attempt to use vague or abstract traditional terms as technical terms. In addition to *language*, there are several other relevant terms that invite suspicion: *thought*, *culture*, *mind*. All these terms are vague, ambiguous, and abstract. To be abstract means to be removed from observable reality. They may even be based on illusion. Terms that are vague and ambiguous mean different things to different people. These are just traditional terms of English, handed down through generations of folk tradition. How can such terms be used as a basis for scientific endeavor?

Let us look more closely at this elusive (and illusory?) term 'language'. First, to say that it is ambiguous is an understatement. It has at least four different meanings (Lamb 2004b): (1) a set of sentences (Chomsky) or utterances (Bloomfield); (2) the system that underlies such productions; (3) processes of speaking and comprehending; (4) the propensity and ability of children to learn languages (in sense 2) (Pinker 1994). All four of these meanings are abstract and therefore suspect. Also, a term with multiple meanings lends itself to what Hockett has called 'Tarzan reasoning', in which one swings from one meaning to another like Tarzan swinging from one tree to another using a vine. Hardly a type of reasoning to be used in scientific discourse. Pinker (1994:18) has provided a good example (cf. Lamb 2004b), with a line of argument which concludes that language is an instinct, conveying 'the idea that people know how to talk in more or less the sense that spiders know how to spin webs'.

However, for the sake of linguistics and in recognition that this field is certainly concerned with languages in some sense of that vague term, we should try to look behind the term and find some tangible and observable reality. There is indeed a readily observable reality behind the term: human beings speaking to one another. On observing such speaking, we can readily see (or hypothesize, if we are being especially careful) that (1) such speaking is organized and systematic, and that (2) communication is generally more or less effective.

Victor Yngve has presented arguments similar to these in a series of LACUS papers and in his book *From Grammar to Science* (1996). He proposes what he calls the *linkage,* which models an *assemblage* (of communicating persons) as a basic concept to be used in building a scientific linguistics. He defines an assemblage as 'a group of people together with their linguistically relevant surroundings involved in particular communicative behavior' (Yngve 1996:86). I find two problems with this approach. First, the linkage is an abstraction from people, and any abstraction must be considered questionable. One question, for example: why choose this particular abstraction (the linkage) rather than some other, from among all the phenomena involved in communication? Second, the research that has appeared based on the linkage, in various writings of Yngve and others (again, see recent issues of the *LACUS Forum*), does not relate well to linguistics as we have known it. Rather than

linguistics, it might better be called the sociology of communication. This is not to criticize sociology of communication. Surely it is a worthy pursuit. On the other hand, it should be added that Yngve also allows for a focus on the properties of the communicating individual. That focus is much more compatible with what is advocated in the present paper.

What I propose as a starting point for further investigation is *the system used by people for their linguistic activity*. In this last sentence, the term *system* is intended to be a neutral term, free of preconceptions. What we are interested in is whatever it is that makes it possible for a person to engage in linguistic activities. The nature of whatever that is is what needs to be investigated. Of course, we need to ask whether this system is a concrete observable object/phenomenon. But first, we need to be clear about what is meant by the term linguistic activity.

Linguistic activity includes, of course, speaking and comprehending. It seems reasonable also to include writing and reading. In addition, since we are attempting to be realistic, we should include thinking; not all thinking, but all that which is linguistically based, that which uses inner speech, the internal monologue. Most people probably engage in this activity more than in either speaking or comprehending speech. We should also add the processes of learning how to engage in these activities and expanding our capabilities, for example by the learning of new lexemes.

Since people do indeed engage in such activities, we can realistically conclude that they have the means to do so. That is what I am referring to as a system. Our job, then, is to examine the nature of this system. Such considerations will bring us into direct relationship with neuroscience, one of the biological sciences.

To recap, what we have so far is, first, the observation that people talk to one another. Therefore, they have some means for doing so. To proceed, we need to give a name to this means. It can be called their *linguistic system*. Now, the preceding sentence is ambiguous: it could be interpreted as suggesting that different communicating individuals have the same system. Of course, we do not want to suppose any such thing. And in fact the frequent occurrence of misunderstanding suggests quite the contrary. A more careful wording of that sentence would therefore be: for each such individual, the means may be called his/her *linguistic system*. Based on observation of people's linguistic activity, it seems to be safe to conclude (1) that a person's linguistic system operates (e.g. for speaking and understanding), and (2) that it has been acquired and is further expandable, adaptable, and otherwise changeable.

In keeping with the reservations mentioned above about terminology, we may note that the term *linguistic system* is not an ordinary term of English. Therefore (unlike *language*, *word*, *meaning*), it is not associated with various concepts from tradition, most of which may be irrelevant and misleading. Rather it is adopted without preconceptions for application to concrete phenomena. And so we do not assume that different people have the same linguistic system, nor that a person's linguistic system consists of rules, nor that it has a form prescribed by some pre-existing linguistic theory, and certainly not that it is genetically determined by a language gene.

Based on readily observable facts about people, I take it as beyond question that a linguistic system, whatever form it has, has to be usable for speaking and understanding

and must be able to acquired and modified. Moreover, there has to be a place where it is located.

This brings us to the next point: what is that place where this system is located? The answer is already available, thanks to generations of work by neurologists and neuroscientists, including neurolinguists. This system is in the brain, mostly in the cerebral cortex. Recognition of this fact, an established scientific finding, brings linguistics into direct relationship with the biological sciences.

In keeping with the cautions mentioned at the outset of this paper, we may next consider two questions:

(1) Is the linguistic system a real physical object?
(2) Is the linguistic system observable?

To the first question we can give a clear affirmative answer. The brain, including the cerebral cortex, is a real physical object. For the second question, the answer is not so simple. Observation is indeed possible, although it is indirect. But that indirectness does not disqualify the investigation as unscientific. A large amount of scientific observation is indirect, for example in astronomy and in particle physics.

There are several methods of observation that provide information for a scientific linguistics. Let us begin with neuroanatomy, as it provides the basis for all the others. Neuroanatomy may be considered at a macroscopic scale and a microscopic scale. The macroscopic scale is concerned with the two hemispheres, the four lobes of each hemisphere (frontal, temporal, parietal, occipital), and the subdivisions of the lobes, with their sulci and gyri (see *http://www.rice.edu/langbrain/cglidden/telen.html*). At the microscopic level we have the six layers of the cortex and the neurons and their components such as axons and dendrites as well as both smaller (e.g. ion channels) and larger units. A larger unit of basic importance is the cortical column, a bundle of neurons (Mountcastle 1998).

An area of indirect observation that is well over a hundred years old is aphasiology, the study of damage to the linguistic system resulting from strokes, injuries, etc. (Benson and Ardila 1996). In recent decades a number of additional techniques of observation have been developing. Perhaps most important is brain imaging, which has three main varieties based on different technologies: positron emission tomography (PET), magnetic resonance imaging (MRI), and the most recent and potentially most useful for linguistics, magnetoencephalography (MEG) (cf. Papanicolaou 1998). Additional techniques of observation include transcortical magnetic stimulation (TMS), which induces temporary local dysfunction, and the use of microelectronic probes during neurosurgery. In addition, many inferences can be drawn from observing the linguistic behavior of people.

Based on abundant research that has been undertaken using these various types of evidence, we have important findings about the linguistic system for which the evidence is by now quite clear. First, we know that a person's linguistic system is largely represented in his/her cerebral cortex. Further, we know that the cerebral cortex is a network. It is easy to suppose that the nodes of the network are neurons and that the connections are nerve fibers, axons and dendrites. And ultimately it is so. But there is now a large amount of

evidence indicating that a better understanding of the function of the cortex in processing information is provided by a conception in which the nodes are columns of interconnected neurons (Mountcastle 1998).

In either case, whether the network is viewed as a network of neurons or a network of cortical columns (and of course it is both, since the column is a network of neurons), we have now arrived at a very important conclusion: *the linguistic system is a network*. From now on I will use the term node to refer to either neuron or column.

The observation that a linguistic system is a network leads directly to others and forces us to reject a number of hypotheses that have been proposed in linguistics over the years. Most rejectable perhaps is this: the brain, hence the linguistic system, operates by means of symbols. Related to this false notion is the corollary that neurons or columns of neurons store symbolic information. But the symbolic information that seems to be so characteristic of language is not directly represented in the cortex at all. Neurons and cortical columns operate by emitting electrical activation to other nodes. This activation typically goes to multiple other nodes in parallel, and it varies in amount, depending on the amount of activation being received. A node accomplishes what it does by virtue of what other nodes it is connected to, not by virtue of any symbolic information it contains.

A great deal is known about the various kinds of connections among nodes. The most basic distinction is perhaps that between local and long-distance connections. The well-known distinction between gray matter and white matter relates to this point. The gray matter consists mainly of columns of neurons. It also includes local connections among adjacent columns. The white matter is composed of long-distance connections (axons), from one part of the cortex to another. (A schematic depiction of a linguistically important bundle of long-distance fibers may be seen at *http://www.rice.edu/langbrain*.) Connections come in varying degrees of strength, and they become stronger with successful use. This dynamic property enables the networks to increase the amount of information they can handle and to adapt to new situations and changing circumstances. Also important is the distinction between excitatory and inhibitory connections. Excitatory connections are both local and long-distance, while inhibitory connections are local only.

Another well-established fact from neuroscience is the correlation between perceptual functions and cortical areas. The primary visual area is in the occipital lobe of both hemispheres, and higher-level visual integration takes place in successive stages in areas progressively anterior to the primary visual area, extending into the temporal lobe (the **what** pathway) and into the parietal lobe (the **where** pathway). The auditory and somatosensory areas are similarly stratified, in that each has a primary area, most closely connected to the sensory input, and successive stages of higher-level integration in areas spreading out from these primary areas. The auditory area is in the temporal lobe and the somatosensory area is in the parietal lobe.

As might be expected from this brief account, speech recognition is likewise in the temporal lobe, since it is based on auditory information. The evidence indicates that nodes for phonological forms that have been learned by an individual, such as syllables and phonological words, are in the posterior portion of the upper temporal lobe, just posterior to the primary auditory area. This is the area known as Wernicke's area.

Control of motor activity resides in the frontal lobe, and it is here that we, accordingly, find control of speech production, in Broca's area, just anterior to the portion of the primary motor cortex that controls the operation of the speech organs.

Of course, these two areas of basic linguistic importance, Wernicke's area and Broca's area, have to be connected. And indeed they are, by what is perhaps the linguistically most important fiber bundle of the cortex, the arcuate fasciculus (see depiction at *http://www.rice.edu/langbrain* or in Lamb 1999:368).

Let us now consider, as a simple example, the form *dog* of English. What gets activated in the cortex by hearing such a form is a network comprising an auditory image in the auditory area of the temporal lobe connected to a node in Wernicke's area that can activate this image and be activated by it. This node is connected by the arcuate fasciculus to a node in Broca's area (frontal lobe) that is further connected to nodes controlling the articulatory gestures that will produce the spoken form that we label *dog*. Now, what about the meaning of this word? The meaning of even such a simple word as *dog* is rather complex. It includes, among other things,

(1) what a dog looks like – a visual network of hundreds or thousands of nodes
(2) what a dog sounds like (barking and whining) – an auditory network
(3) what a dog feels like to the touch – a somatosensory network

Moreover, these networks must be connected, directly or indirectly, to the phonological form for *dog*. At this point, the evidence from neurolinguistics remains a bit hazy, but it is likely that there is a lemma (lexical) node in the angular gyrus, in the lower part of the parietal lobe close to Wernicke's area, that has connections to the phonological node (in Wernicke's area) and to these three sensory-perceptual networks as well as to various items of abstract information associated with dogs and their behavior. This abstract information is of course quite variable across individuals, depending as it does upon their various experiences with dogs and with the varying amounts of abstract knowledge they have acquired about these animals—some of it from direct experience, some from hearsay, some from reading, etc.

And so what we have, for this one simple word, is a vast and complex network. But it is formed entirely of nodes and their interconnections. It is important to realize that many, indeed most, of the nodes of this network are shared by other networks, for example those for cats and bears; and on the phonological side, those for *dawn, hog, log*, etc. What keeps all of these various networks distinct from one another is the non-shared convergence nodes that are dedicated to their unique functions, such as the phonological node for *dog* and the lemma node for *dog*. These convergence nodes also make possible the reactivation of the networks under appropriate circumstances. For example, when you hear the word *dog*, the phonological node is activated, and activation spreads on to the lemma node and from there to the various sensory-perceptual networks for DOG. (Clearly, it's no good to have a lot of information represented if it can't be appropriately reactivated, while not being inappropriately activated.)

One of the beautiful properties of our neurocognitive systems is that such reactivation of acquired information operates in different directions. Upon seeing a dog, for example, activation proceeds from the retinas to the primary visual cortex to higher level visual strata, ultimately (in about 150–200 milliseconds) activating the high level visual nodes dedicated to DOG, from where it can continue to the lemma node and on to the phonological node, and further to the articulatory node in Broca's area, from which activation can further spread to the muscles which allow the person in question to say 'I see a dog', or whatever else is appropriate to the situation. Alternatively, a person can hear the spoken word, which sets up activation from the cochlea to the primary auditory area, from where it spreads to Wernicke's area, from there to the lemma node, and on to the sensory-perceptual networks. The end result is that upon hearing the spoken representation of the word *dog*, one is able, for example, to visualize a dog.

What makes such bidirectional processing possible is the existence throughout the cortex of reciprocal connections between cortical areas (Lamb 2004c). That is, most cortico-cortical connections are bidirectional. This is an established finding of neuroanatomy. It is not that the connecting nerve fibers are in themselves bidirectional. Rather, it is that we find different but roughly parallel fibers going in opposite directions.

For those who may be skeptical about the existence of uniquely dedicated convergence nodes at higher levels, it may be mentioned that we have abundant evidence for such highly specific local representations of high-level information from detailed studies of auditory, somatosensory, and visual perception in various mammals (Mountcastle 1998).

In case it is not by now apparent, let me state outright that we now have the answer to the elusive question of meaning that has perplexed linguists and philosophers and that has led Yngve (1996) to reject much of linguistics because of its preoccupation with meaning as fundamental in the study of language. As mentioned at the outset, it is commonly supposed that words have meanings. As Yngve and others have correctly pointed out, this notion makes no sense. But lurking behind it we can see, through the scientific approach advocated here, making use of observation and the findings of the neurosciences, that there is a reality. It is not the case that words have meanings. Rather, it is the case that, *in the cerebral cortex of an individual, the network activated by the spoken form of a word is connected (in multiple steps) to a cortical network representing information pertaining to that word*. Speaking more loosely, we may say that cortical representations of spoken words *are connected to* cortical representations of their meanings. In keeping with the approach advocated above and followed throughout this paper we must also recognize that no two people can be expected to have exactly the same meaning for a word.

What, then, are we to make of all the work that has been done in linguistics based on previous conceptions of meaning? Must it be thrown out because of these basic misconceptions? An alternative is to make the necessary adjustments to allow some of this work to be accepted as scientifically useful. Consider, for example, the so-called cognitive linguistics of Langacker and others. Langacker (e.g. 2000) proposes that a language consists of symbolic units, and that each symbolic unit is a pairing of a form with a meaning. Symbolic units include not only fixed forms like words and phrases but also constructions. It appears that the large amount of work that has been done using this conception can easily

be accommodated as scientifically valid if we use just a little flexibility in our thinking, for Langacker's conception can easily be given an interpretation in terms of relational networks as outlined above. The first accommodation is achieved by changing *language* in the above statement to *linguistic system* (that is, of an individual). The second accommodation is to see that a symbolic unit is a network, in which two portions can be distinguished, one of which represents the form while the remainder represents the meaning. And since the form activates the meaning while the meaning activates the form, the relationship between the form and the meaning of a symbolic unit is that they are connected. Moreover, as mentioned above, the connection is bidirectional, because of the existence in the cortex of reciprocal connections between cortical areas.

The principle just illustrated may be called **accommodation**. Any prescientific work in linguistics may be said to be accommodated by scientific linguistics if its underlying conceptions can be reinterpreted in terms of networks as implemented in the brain.

What other work can be accommodated? Since it has been shown (Lamb 1999) that relational networks can be viewed as abstract representations of cortical networks, it would appear that, in general, research done using the relational network model, by Bennett, Lockwood, Makkai, Reich, Sullivan, and others, can be accommodated as scientifically valid. This appraisal must be qualified, however, by the consideration that the neurocognitive basis of language has not one but two phonologies, both articulatory and auditory, relating to Broca's area and Wernicke's area, respectively. Therefore, all earlier work in phonology, including that done using the relational network model, must be reappraised. Most of it appears to represent articulatory phonology and may therefore be valid for that side of phonology.

It is likely also that much additional work in prescientific linguistics can be accepted as scientifically valid, as it reflects a concern for reality and is based on conceptions that can be accommodated into the neurocognitive conception. Here I can mention the work on discourse analysis of Halliday, Longacre, Shin Ja Hwang and others.

But all such accommodation must include recognition that every individual has his/her own linguistic system. To be sure the different systems of people said to speak the same language have greater or lesser amounts of overlap, and to the extent that there is overlap we tend to communicate successfully. But a unified linguistic system for a community exists only in the realm of illusion.

In conclusion, the individual linguistic system is a concrete observable physical object and therefore a valid object of scientific investigation. Examination of that system reveals that it is a network represented in the cerebral cortex having many features in common with the networks of relational network linguistics (Lamb 1999). It appears that some of the intuitions of prescientific linguistics, along with the findings resulting from research based on these intuitions, can be given scientific interpretations. A prime example is the notion of meaning: The meaning of a form is represented in the linguistic system as a cortical network, and the form is likewise represented as a cortical network; and the relationship between the representations of the form and the meaning is simply that they are bidirectionally connected.

In summary, I suggest the following:

(1) To be realistic we must start not with words like *language*, but with observable phenomena.
(2) For linguistics, an appropriate first observation is that people talk to one another.
(3) They must therefore have some means that allows such talking and understanding to occur.
(4) That means can be called a linguistic system
(5) A person's linguistic system is largely in that person's cerebral cortex.
(6) It has the form of a large dynamic network.
(7) Many of the findings of prescientific linguistics can be given scientific interpretation in these terms.

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EME-WARE: FROM EMIC ANALYSIS TO PRACTICAL INPUT SYSTEMS[1,2]

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In the twenty-first century, for good or ill, the personal computer (PC) will replace pen and paper as the medium for the average, educated participant in global society and commerce to record, explore, manipulate, and communicate thought. So-called productivity applications—such as word processors, e-mail, and instant messengers—will increasingly be used as the medium for written (sic) communication in all the world's languages, and the symbols for communications will expand beyond language (e.g. the use of emoticons).

Unfortunately, from the 1940s through the 1980s, the PC was designed for use almost exclusively for the English language. Although recent decades have seen software makers begin to address non-English languages, it is still the case that—for use in any language (or with any input set) other than English—there is an additional language-dependent degree of difficulty for entering basic elements into productivity applications. The degree of deficit is dependent on a measure we at MindStride informally call the **distance** between English and the (target) language or input set. The concept of **distance from English** can be made more rigorous, but since we focus on input methods production and not their categorization, we are generally satisfied to relate it to the number of separate scripts in the language[3] as well as the number of non-keyboard symbols in common use. We then use the measure to estimate that the following input sets are increasingly **far from English** (with commensurately increasing **input efficiency deficits**):

1. Spanish (**Figure 2**)
2. Vietnamese (**Figure 5**)
3. 'European Languages' (**Figure 8**)
4. Japanese (**Figure 9**)
5. Korean (**Figure 10**)
6. Chinese (**Figure 11**)

Given the impracticality of reducing input efficiency deficits with input-set-specific keyboards,[4] the most common tactic—that taken by MindStride and other organizations—is to develop software (**input methods**)[5] that enables users to send symbols to productivity applications. Input methods are more or less **elegant** to the degree that they make the input task:

- Easier (fewer, rapidly learned, simple gestures producing more input symbols)[6]
- Faster (greater count of input symbols per unit of time)
- More accurate (fewer gestures wasted on unintended symbols)

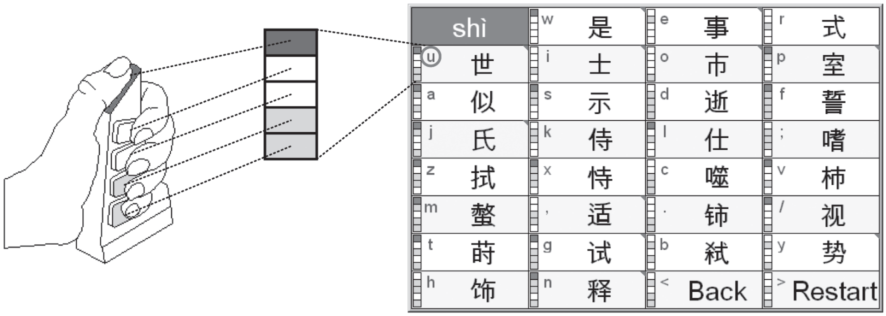

Figure 1. *Chordal input device with Chinese input method.*

The asymptotes of an ideal (maximally elegant) input method are indicated by a *reductio ad absurdum* specification: it takes *no* time to learn to *instantaneously* input a *maximal* sequence of desired symbols from a *maximal* range of symbols using a *minimal* set of unique gestures to select from *minimal* sets of choices arranged in *minimal* sequences.

It is interesting, possibly useful, and certainly maddening to speculate that the practical limits to input method elegance are user languages for ranges of symbols and associated sequences of phonemes for speed and gesture range size. The implications of such speculation together with observations of competing phonemic and linguistic analyses for specific languages is a strong indication that no system (MindStride's included) will automatically result in the single best input method for a given language, but also an indication that the limits of elegance can be approached.

MindStride input methods are based on **emic** (e.g. graphemic, phonemic) analyses of input sets, as well as an understanding of the average, educated, input set user. Each analysis is optimized to take best advantage of the features of the MindStride Input Engine to maximize gestural efficiency and learnability. Input set analyses for Spanish, for Vietnamese, and for European languages taken as an aggregate illustrate that, as with linguistic analyses in general, input set analysis (and therefore input method development) is as much art as science.

1. MINDSTRIDE INPUT ENGINE. The MindStride Input Engine displays grids of choices (**Figure 1**) that indicate how to use input devices to select input choices.

Users make selections with the devices in the standard way:

- **Mouse/Stylus**: Click anywhere on the cell containing the choice.
- **Keyboard**: Type the key indicated in the upper left corner of the cell.
- **Chordal Devices**: Press and release the finger combination in the cell.

Selections either:

- Cause input to be sent to (e.g.) productivity applications for simple inputs, or
- Cause display of subsequent choice grids in sequences leading to complex inputs.

Because MindStride can be actuated by combinations of five fingers on chordal devices, there is an additional constraint of limiting the number of grid choices to 31 ($= 2^5 - 1$).

MindStride's **Press & Hold (P&H)** feature[7] enables users to access alternative inputs or alternative subsequent grids (indicated by a red tic-mark in the upper right corner of the cell). P&H is activated by:

- **Mouse/Stylus**: Instead of clicking on the cell, sustain the press for a short period.
- **Keyboard**: Instead of releasing the key immediately upon typing it, hold it down.
- **Chordal Devices**: Press and hold the finger combination indicated in the cell.

In all cases, feedback is provided when the sustained activation time is reached. There are three different P&H actions: **P&H Repeat, P&H Grid, and P&H Selection**. **P&H Repeat** sends the selection to productivity applications for as long as the device is actuated. **P&H Grid** causes MindStride to display an alternative successor grid. **P&H Selection** displays new selections in place of current selections; completing the input device gesture causes MindStride to send the selection to the productivity application.

Users change the interval MindStride waits before responding to P&H by changing a configuration value.

2. INPUT DEVICES. Most input devices (mouse, stylus, joysticks, etc.) are unmarked. Using MindStride with these devices is simply a matter of using the device in the standard way for sequence choice selection, and in an easily learned, intuitive way for the expanded selections available via the P&H feature.

As intimated prior, there are 31 possible combinations of 5 fingers taken 1, 2, 3, 4, or 5 at a time. So, for optimal operation with chordal devices, software (including input methods) must offer a maximum of 31 choices to its users at any one time.[8] MindStride has found it most useful to indicate chordal operation by visually associating input sequence choices with **ChordMaps** (**Figure 1** shows vectors of five juxtaposed blocks: filled blocks indicating pressed fingers; empty blocks indicating un-pressed fingers).

Consideration of the field of input devices will reveal why the keyboard, although most common and arguably most useful, is also the most challenging input device to accommodate with a software input method. The keyboard, in that the device itself comprises a multiplicity of 'named' keys, which names are integral to its operation, forces input methods to visually associate keys with non-key inputs and with sequenced sets of choices leading to inputs (e.g. pinyin letters leading to Chinese characters). The choice of key to associate with sequence choice is a major consideration in input method development (upper left hand corner of each grid cell in **Figure 1**). And, in part because keys are often more familiar than the inputs themselves, a secondary issue is the order in which the associations are presented to the user.[9]

3. SPANISH LETTERS INPUT METHOD. Because, by our measure, Spanish is fairly close to English, dEspañol™—MindStride's Spanish letter input method—is a complete example of identifying the emic level(s) (e.g. graphemic, phonemic, morphemic, sememic) at which

á é í ó ú ü ñ Á É Í Ó Ú Ü Ñ ¿ ¡ € « » ª º

Figure 2. *Common non-keyboard symbols for Spanish.*

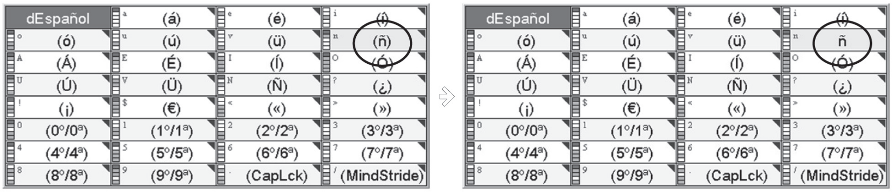

Figure 3. *(dEspañol) Press & Hold of* ***n*** *key causes input of the letter* ***ñ****.*

analysis, science, and art yield optimal input methods for intuitive sequence choice presentation to the average, educated user of an input set.

The problem, amenable to many solutions (of less or more elegance) is to make it easy, fast, and accurate for the user to access non-keyboard characters commonly used in producing written Spanish documents (**Figure 2**).

Visual inspection of the domain indicates that a graphemic approach is possible. Emic analysis is fairly straight-forward; the non-keyboard-key graphemes of the system can be named by:

{'Acute' 'Diaeresis' 'Tilde' 'Inverted' '€' 'Double' 'Superscript'}

With the exception of {'Diaeresis' 'Superscript'}—and with an excursion into the sememic domain by noting that the keyboard symbol **$** and the non-keyboard symbol **€** are both **currency indicators** for the average, educated Spanish speaker—the emes are in one-one correspondence with {'Keyboard Symbol'}, yielding the (Keyboard Symbol:Non Keyboard Symbol) map:

{a:á e:é i:í o:ó u:ú n:ñ A:Á E:É I:Í O:Ó U:Ú N:Ñ ?:¿ !:¡ <:« >:» $:€}

dEspañol uses the P&H feature to enable users to input the non-keyboard symbols from the map by **holding** the associated key; so, for instance, the letter **n** is input by typing the **n** key normally, and the letter **ñ** is input by holding the same key down for a slightly longer period of time. The software gives visual feedback in the form of removing parentheses around the desired input to let the user know when the key has been held sufficiently long (**Figure 3**).

The advantages of the P&H implementation are:

- It doesn't interfere with prior existing skills; specifically, the keyboard and mouse are used in the accustomed manner.
- Additional learning and memorization are extremely minimized; the desired input is already visually (graphemically) associated with the key and the single, additional skill of holding a key down is readily learned.

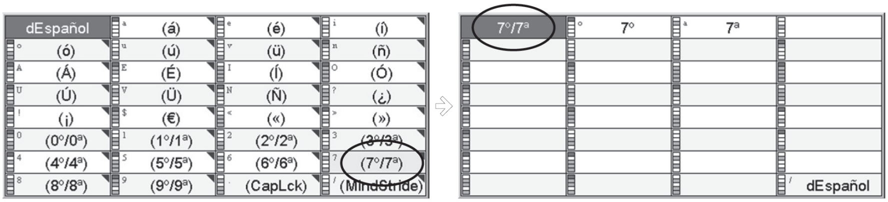

***Figure 4.** (dEspañol) P&H of digit keys causes ordinalizing superscript display choice.*

The remaining emes, {'Superscript' 'Diaeresis'}, if implemented with P&H for graphemically associated keyboard symbols, would conflict with existing mappings; for example the key **a** cannot be associated with both **á** and **ª** for efficient use of the P&H feature.

An elegant solution (**Figure 4**) for the ordinalizing superscripts **ª** and **º** takes advantage of the (quasi-morphemic) observation that they occur only after digits **0–9**; that is **0**–**9** are emic contexts for both. So, rather than associating ordinalizers with corresponding keyboard keys, dEspañol presents ordinalizer choices when users hold the digit keys and enables selection of the particular ordinalizer by typing (not holding) the associated key.

The last remaining issue is the eme {'Diaeresis'} associated with the letters **ü** and **Ü**. Interviews with many educated, literate users indicate that overloading the **u** key is less convenient than associating the dieresis on a P&H basis with the letters **v** and **V** (historically used to indicate the letter **U**).

The process for creating dEspañol was:

1. Determining the most useful eme is (primarily) graphic—rather than, say, phonemic.
2. Identifying strategic emes.
3. Applying science (e.g. to symbols that map uniquely to keyboard keys).
4. Applying art (e.g. determining contexts to avoid overloading keyboard symbols).

One result of applying art in this case resulted in making the sacrifice of a single, moderate inconvenience (associating the **v** and **V** keys with the symbols **ü** and **Ü**) to avoid the more egregious inconvenience of overloading two keys. Elements of the same analytic process were used in the development of **dViệt-ngữ**™—MindStride's Vietnamese input system.

4. VIETNAMESE LETTERS INPUT METHOD. The most salient difference between Spanish and Vietnamese (for the purposes of designing an input method) is the larger counts of variations of keyboard symbols (e.g. **Figure 5**, overleaf, contains 18 variations of the letter **a**, including the symbol itself).

As with dEspañol, to preserve intuitiveness and not to interfere with pre-existing typing skills, each set of variations is accessed via P&H from the key (visually/graphemically) associated with the variations. If there is only one variation (e.g. **đ**, **Đ**), P&H Selection is used to input the variation. If there are multiple variations, the P&H Grid feature displays the choices for variations to be selected.

		á	Á	à	À	ả	Ả	ã	Ã	ạ	Ạ
ă	Ă	ắ	Ắ	ằ	Ằ	ẳ	Ẳ	ẵ	Ẵ	ặ	Ặ
â	Â	ấ	Ấ	ầ	Ầ	ẩ	Ẩ	ẫ	Ẫ	ậ	Ậ
đ	Đ										
		é	É	è	È	ẻ	Ẻ	ẽ	Ẽ	ẹ	Ẹ
ê	Ê	ế	Ế	ề	Ề	ể	Ể	ễ	Ễ	ẹ	Ẹ
		í	Í	ì	Ì	ỉ	Ỉ	ĩ	Ĩ	ị	Ị
		ó	Ó	ò	Ò	ỏ	Ỏ	õ	Õ	ọ	Ọ
ô	Ô	ố	Ố	ồ	Ồ	ổ	Ổ	ỗ	Ỗ	ộ	Ộ
ơ	Ơ	ớ	Ớ	ờ	Ờ	ở	Ở	ỡ	Ỡ	ợ	Ợ
		ú	Ú	ù	Ù	ủ	Ủ	ũ	Ũ	ụ	Ụ
ư	Ư	ứ	Ứ	ừ	Ừ	ử	Ử	ữ	Ữ	ự	Ự

Figure 5. *Non-keyboard symbols for Vietnamese.*

The multiplicity of keyboard symbol variations makes overloading keys unavoidable, so the principal remaining issues in the design of dViệt-ngữ are:

- How to order the variations
- How many gestures to associate with the variations
- Which keys to associate with the variations

Visual inspection indicates that the non-keyboard-key graphemes of the input set can be named by

{'Breve' 'Circumflex' 'Horn' 'Stroke' 'Acute' 'Grave' 'Hook' 'Tilde' 'Dot'}[10]

The collating order for the standard Vietnamese alphabet (quốc ngữ)

a ă â b c ch d đ e ê g gi h i k kh l m n ng nh o ô ơ p ph q r s t th tr u ư v x y

yields a useful primary ordering:

{'Breve' 'Circumflex' 'Stroke' 'Horn'}

while the received pedagogical order for tones yields a secondary ordering:

{'Acute' 'Grave' 'Hook' 'Tilde' 'Dot'}[11]

So, dViệt-ngữ presents the multiple key symbol variations in the order of **Figure 5**.

dViệt-ngữ takes two simultaneous approaches to addressing the design issues of gesture count per symbol and key-to-symbol associations.

Grapheme	Key	Keyname
Breve	(	Left paren
Circumflex	^	Circumflex
Horn	,	Comma
Acute	'	Apostrophe
Grave	`	Grave
Hook	?	Question mark
Tilde	~	Tilde
Dot	.	Period

Figure 6. *Mnemonics for Vietnamese vowel marks.*

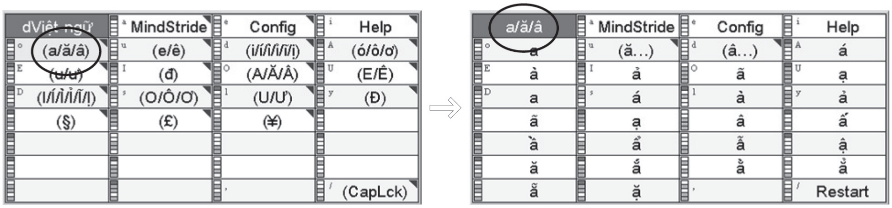

Figure 7. *Two different approaches for overloaded Vietnamese letters.*

The first approach—for users whose primary input device for Vietnamese is not the keyboard or who want to maximize long-term productivity—minimizes gesture count per symbol at the expense of a slight learning curve. This **minimal sequence** approach associates single keys with each of the (maximum 18) vowel variations. Mnemonics are impractical, so, to facilitate learning, the arrangement of associated keys follows their physical layout on the keyboard. The associations remain constant for same variations of different keyboard symbols (e.g. **Ẫ** and **Ỗ**) and are learned, via repetition, in fairly short order (approximately two hours of typing). Because it halves the gesture count for most Vietnamese symbols, the minimal sequence approach also reduces fatigue if the primary input device for Vietnamese is a mouse, stylus, or chordal device.

The second approach—for users willing to sacrifice some speed for virtually no learning curve—associates keys with each of the graphemic components of the keyboard key variations. Since most variations have two separate marks, the strict graphemic approach forces the user to type two keys for many Vietnamese letters, but involves only 8 easily learned, visually mnemonic associations of keyboard symbols with graphemic elements (**Figure 6**).

dViệt-ngữ implements both approaches in the same display so users can easily choose which approach they prefer (**Figure 7**). Rows 2–3 implement the strict graphemic approach and rows 4–8 implement the minimal sequence approach.

Due to the greater distance from English for Vietnamese, the design of dViệt-ngữ involves both more science and more art than the design of dEspañol. Science assists in determining that a graphemic approach is reasonable, in identifying the individual graphemes, and in ordering the graphemes. Art is used to determine presentation ordering principles (by

·	ķ	Ọ	ọ	ĵ	Ɵ	ϵ	ș	ț	Ș	Ț		–	—	ˆ	¡	¦	¨	¯
´	¸	¿	!	˜	ʼ	ˏ	˛	;			‘	’	‚	“	”	„	‹	›
±	«	»	×	÷	|	‖	ǂ	¢	£	¤	¥	§	©	¬	®	°	µ	¶
	†	‡	•	…	‰	€	¼	½	¾	¹	²	ƻ	³	Ƽ	ƽ	ª	Á	á
À	à	Ậ	â	Ä	ä	ă	Ă	Ă	ă	Ā	ā	Ã	ã	Å	å	Ą	ą	ǡ
Ǟ	ǻ	Ǻ	ǟ	Ǟ	ȁ	Ȁ	ȃ	Ȃ	Æ	æ	ǽ	Ǽ	ǣ	Ǣ	ƀ	Ɓ	ƃ	Ƃ
ь	Ь	Ć	ć	Ċ	ċ	Ĉ	ĉ	Č	č	Ç	ç	ƈ	Ƈ	Ɔ	Ď	ď	Đ	đ
ƌ	Ƌ	Ɖ	Đ	ð	ƍ	dz	Dz	DZ	dž	Dž	DŽ	Đ	É	é	È	è	Ė	ė
Ê	ê	Ë	ë	Ě	ě	Ĕ	ĕ	Ē	ē	Ę	ę	ȅ	Ȅ	ê	Ê	Ɛ	ə	Ǝ
Ə	Ƒ	ƒ	ƒ	ǵ	Ǵ	Ġ	ġ	Ĝ	ĝ	ǧ	Ǧ	Ğ	ğ	Ģ	ģ	ɡ	Ǥ	Ɠ
Ɣ	Ĥ	ĥ	Ħ	ħ	ƕ	ı	Í	í	Ì	ì	İ	Î	î	Ï	ï	ǐ	Ǐ	Ĭ
ĭ	Ī	ī	Ĩ	ĩ	Į	į	Ɨ	ȉ	Ȉ	ȋ	Ȋ	ɩ	Ĳ	ĳ	Ĵ	ĵ	ǰ	ĸ
ǩ	Ǩ	Ķ	ķ	ƙ	Ƙ	Ĺ	ĺ	Ŀ	ŀ	Ľ	ľ	Ļ	ļ	Ɨ	Ł	ł	ƛ	ǉ
ǈ	Ǉ	Ɯ	Ṅ	ń	Ň	ň	Ñ	ñ	Ņ	ņ	Ŋ	ŉ	ŋ	ǌ	ǋ	Ǌ	Ŋ	ŋ
º	Ó	ó	Ò	ò	Ô	ô	Ö	ö	ǒ	Ǒ	Ŏ	ŏ	Ō	ō	Õ	õ	ǫ	Ǫ
Ő	ő	Ɵ	Ø	ø	ǿ	Ǿ	ǭ	Ǭ	ȍ	Ȍ	ô	Ô	ơ	Ơ	ƣ	Ƣ	Œ	Œ
œ	œ	ƥ	Ƥ	Ŕ	ŕ	Ř	ř	Ŗ	ŗ	ȑ	Ȑ	ȓ	Ȓ	Ʀ	Ś	ś	Ŝ	ŝ
Š	Š	š	š	Ş	ş	Σ	ʅ	ƨ	Ƨ	ß	ʃ	Ť	ť	Ţ	ţ	ƫ	Ƭ	ţ
Ʈ	Þ	þ	™	Ŧ	ŧ	Ú	ú	Ù	ù	Û	û	Ü	ü	ǔ	Ǔ	Ū	ŭ	Ū
ū	Ũ	ũ	Ů	ů	Ų	ų	Ű	ű	ǘ	Ǘ	ǜ	Ǜ	ǚ	Ǚ	ǖ	Ǖ	ȕ	Ȕ
û	Û	ư	Ư	Ʊ	Ʋ	Ŵ	ŵ	ƿ	Ý	ý	Ŷ	ŷ	Ÿ	Ÿ	ÿ	ɣ	Ƴ	Ź
ź	Ż	ż	Ž	Ž	ž	ž	ƶ	Ƶ	Ʒ	ǯ	Ǯ	ƹ	Ƹ	ƺ	ƾ	Α	α	Ά
ά	Β	β	ϐ	Γ	γ	Δ	δ	Ε	ϵ	Έ	έ	Ζ	ζ	Η	η	Ή	ή	Θ
θ	ϑ	Ι	ι	Ί	ί	Ϊ	ϊ	ΐ	Κ	κ	ϰ	Λ	λ	Μ	μ	Ν	ν	Ξ
ξ	Ο	ο	Ό	ό	Π	π	ϖ	Ρ	ρ	ϱ	Σ	σ	ς	c	Τ	τ	Υ	υ
Ύ	ύ	Ϋ	Ϋ	ϋ	ΰ	ϒ	ϓ	Φ	φ	ϕ	Χ	χ	Ψ	ψ	Ω	ω	Ώ	ώ
Ϛ	ϛ	Ϝ	ϝ	Ϟ	ϟ	Ϡ	ϡ	Ϣ	ϣ	Ϥ	ϥ	ϧ	ϩ	Ȣ	ȣ	Ϫ	ϫ	Ϭ
σ	Ϯ	ϯ																

Figure 8. *Representative non-keyboard symbols for 'European languages'.*[12, 13, 14]

stepping outside the analysis to use the Vietnamese alphabet and the received ordering for tones) and also to decide that it is productive to take two simultaneous approaches in presenting variations for overloaded keys.

5. EUROPEAN LETTERS INPUT METHOD. The letters and symbols of European languages considered as a group (**Figure 8**) serves as an example of an input set that is not (strictly) associated with a single language and as a final example of the science and art of designing input methods.

Many of our users often switch among several languages frequently in their day-to-day use of productivity applications. Several factors (e.g. considerable keyboard familiarity, rapidity and frequency of language switching) indicate that explicitly switching languages would be a frustration compared to simply presenting keyboard symbol variations (*à la* dViệt-ngữ).

Using prior explicated methods, dLinguist™—MindStride's European language input method—uses P&H to access keyboard character variations. Even cursory examination of the range of graphemic elements in keyboard symbol variations indicates it unlikely that art can produce universal mnemonics. So, the design of dLinguist relies mainly on science to identify which variations are most frequent across keyboard symbols[15] and on art, where obvious, to associate the variations with the same subsequent key.

Hiragana (平仮名)

ぁ あ ぃ い ぅ う ぇ え ぉ お か が き ぎ く
ぐ け げ こ ご さ ざ し じ す ず せ ぜ そ ぞ た
だ ち ぢ っ つ づ て で と ど な に ぬ ね の は
ば ぱ ひ び ぴ ふ ぶ ぷ へ べ ぺ ほ ぼ ぽ ま み
む め も ゃ や ゅ ゆ ょ よ ら り る れ ろ ゎ わ
ゐ ゑ を ん ゔ ゛ ゜ ゛ ゜ ゝ ゞ

Count: 90

Katakana (片仮名)

ァ ア ィ イ ゥ ウ ェ エ ォ オ カ ガ キ ギ ク
グ ケ ゲ コ ゴ サ ザ シ ジ ス ズ セ ゼ ソ ゾ タ
ダ チ ヂ ッ ツ ヅ テ デ ト ド ナ ニ ヌ ネ ノ ハ
バ パ ヒ ビ ピ フ ブ プ ヘ ベ ペ ホ ボ ポ マ ミ
ム メ モ ャ ヤ ュ ユ ョ ヨ ラ リ ル レ ロ ヮ ワ
ヰ ヱ ヲ ン ヴ ヵ ヶ ヷ ヸ ヹ ヺ ・ ー ヽ ヾ

Count: 94

Education kanji (kyōiku kanji 教育漢字)

一 二 三 四 五 六 七 八 九 十 百 千 上 下 左 右
数 多 少 万 半 形 太 細 広 長 点 丸 交 光 角 計
主 乗 予 事 仕 他 代 住 使 係 倍 全 具 写 列 助
位 低 例 便 信 倉 候 借 停 健 側 働 億 兆 児 共
個 備 像 再 刊 判 制 券 則 効 務 勢 厚 句 可 営
冊 処 刻 割 創 劇 勤 危 卵 厳 収 后 否 吸 呼 善

Count: 1,006

Daily-use kanji (jōyō kanji 常用漢字)

丈 与 且 丘 丙 丹 乏 乙 乾 了 互 井 亜 享 亭 介
仙 仰 企 伏 伐 伯 伴 伸 伺 但 佐 佳 併 侍 依 侮

Count: 939

Name kanji (jinmeiyō kanji 人名用漢字)

馨 馴 馳 駕 駒 駿 驍 魁 魯 鮎 鯉 鯛 鰯 鱒 鱗 鳩
鳶 鳳 鴨 鴻 鵜 鵬 鶴 鷗 鷲 鷺 鷹 鹿 麒 麓 麟 磨

Count: 983

Total Kana: 184 // Official Kanji: 2928

日本漢字能力検定試験 ('Test of Japanese Kanji Aptitude') ~6000 kanji

Figure 9. *Representative non-keyboard symbols for Japanese.*

For example, each of the **acute** (′) variations of keyboard symbols

{Á Ć É Ǵ Í Ĺ Ń Ó Ŕ Ś Ú Ý Ź á ć é ǵ í ĺ ń ó ŕ ś ú ý ź}

can be input by P&H on the letter, followed by typing the apostrophe.

But examination of the range of variations of (e.g.) the letters **E**, **T** and **S**,

{É € È Ê Ë Ė Ě Ĕ Ē Ę Ȅ Ȇ Ɛ Ǝ Ε Έ Η Ή Ə}
{† ™ Þ Ť Ţ Ŧ Ƭ Ʈ Θ Τ ϯ}
{Ś § Š ß Ŝ Ṧ Ş Σ ʅ Σ Ϛ ↝ Ϣ}

indicates that a comprehensive set of mnemonics, even across just letters, would be so complicated as to defeat the purpose.

Given that any single user is likely to use only very few of the variations in the set, we have found that it is sufficient to rely on repetition to cover the learning curve, so art is neither useful nor necessary, as in the case of dViệt-ngữ.

6. THE LIMITS OF THE GRAPHEMIC APPROACH. Although full analyses and descriptions of input methods for Chinese, Japanese, and Korean are outside the scope of this introduction, it is an interesting, but only seemingly paradoxical, observation that the written languages which graphically vary most are more amenable to input methods based on phonemic (or even morphemic) rather than graphemic analyses.

To understand why phonemic analysis is useful for Chinese, Japanese, and Korean, note that estimates of the number of symbols ranges from 3112 (Official Japanese, **Figure 9**) to 80,000 (every Chinese character ever written, **Figure 11,** overleaf). For each of these ranges, all of the characters are associated with spoken languages that have phoneme counts which

	Totals	Examples
Jamo (자모, 字母)	**51**	
Ja-eum (자음, 子音)	30	
Simple	*14*	ㄱ ㄴ ㄷ ㄹ ㅁ ㅂ ㅅ ㅇ ㅈ ㅊ ㅋ ㅌ ㅍ ㅎ
Double	*5*	ㄲ ㄸ ㅃ ㅆ ㅉ
Clusters	*11*	ㄳ ㄵ ㄶ ㄺ ㄻ ㄼ ㄽ ㄾ ㄿ ㅀ ㅄ
Mo-eum (모음, 母音)	21	
Simple	6	ㅏ ㅓ ㅗ ㅜ ㅡ ㅣ
Yotized	4	ㅑ ㅕ ㅛ ㅠ
Diphthongs	11	ㅐ ㅒ ㅔ ㅖ ㅘ ㅙ ㅚ ㅝ ㅞ ㅟ ㅢ
Obsolete Jamo	**43**	
Ja-eum	34	
Simple	*6*	ㅿ ㆁ ㆆ ㅱ ㅸ ㆄ
Double	*4*	ㅥ ㆀ ㆅ ㅹ
Double Cluster	*20*	ㅦ ㅧ ㅨ ㅪ ㅬ ㅭ ㅮ ㅯ ㅰ ㅲ ㅳ ㅶ ㅷ ㅺ ㅻ ㅼ ㅽ ㅾ ㆂ ㆃ
Triple Cluster	*4*	ㅩ ㅫ ㅴ ㅵ
Mo-eum	9	
Simple	*1*	ㆍ
Dipthongs	*8*	ㅢ ㆎ ㆇ ㆈ ㆉ ㆊ ㆋ ㆌ
Hangul	**11,172**	가 각 갂 갃 간 갅 갆 갇 갈 갉 힚 힛 힜 힝 힞 힟 힠 힡 힢 힣
Hanja (Official)	**1,800**	一 二 三 人 口 子 女 下 上 入 大 小 九 十 土 七 八 中 山 不

Overall Total: 13,066

Figure 10. *Representative non-keyboard symbols for Korean (한국어, 조선어).*

are orders of magnitude smaller. For instance, every Chinese character has one or more of approximately 1280 Mandarin syllabic pronunciations (including tone).

Using a phonemic approach to specify syllables before characters, 舞中文 ('WǔZhōngWén')—MindStride's Chinese input method—enables each syllable to be exactly specified in a maximum of three gestures, then individual characters in a maximum fourth, and words and phrases beginning with the character in a maximum fifth (via Press & Hold).

Graphical input methods based on either the (8) basic strokes or the (200+) composite parts (radicals, 部首 'bùshǒu') require many gestures (e.g. one gesture per stroke) or extraordinary learning curves to memorize associations of keys with components (e.g. 五笔字型 *wǔbǐzìxíng*).

7. CHINESE EXEMPLIFIES COMPLEXITIES OF OTHER LANGUAGES AND INPUT SETS. In developing input methods for a considerable number of languages, it has become apparent that the development of an input method for Chinese illustrates most—if not all—of the difficulties likely to occur in the development of input methods for any language or input set. A full discussion of general input method design issues and considerations as epitomized by 舞中文 can be found in MindStride's white paper, 'Opportunity in Work Clothes: The Development of MindStride's Chinese Input Method',[16] a précis for which follows:

The morass of factual and statistical information about the Chinese language (**Figure 11**) make it very difficult to choose which observations are useful in the design of an efficient, **elegant** input method for average, educated computer users, whether they are learning the

Chinese (汉语/漢語 - Hànyǔ, 华语/華語 - Huáyǔ, 中文 - Zhōngwén)

Pīnyīn Vowels (拼音元音)

ā	Ā	á	Á	ǎ	Ǎ	à	À
ē	Ē	é	É	ě	Ě	è	È
ī	Ī	í	Í	ǐ	Ǐ	ì	Ì
ō	Ō	ó	Ó	ǒ	Ǒ	ò	Ò
ū	Ū	ú	Ú	ǔ	Ǔ	ù	Ù
ǖ	Ǖ	ǘ	Ǘ	ǚ	Ǚ	ǜ	Ǜ

Count: 48

Zhùyīn Fúhào (注音符號)

ㄅ	ㄆ	ㄇ	ㄈ	ㄉ	ㄊ	ㄋ	ㄌ
ㄍ	ㄎ	ㄏ	ㄐ	ㄑ	ㄒ		
ㄓ	ㄔ	ㄕ	ㄖ	ㄗ	ㄘ	ㄙ	
ㄧ	ㄨ	ㄩ	ㄚ	ㄛ	ㄜ	ㄝ	
ㄞ	ㄟ	ㄠ	ㄡ	ㄢ	ㄣ	ㄤ	ㄥ
ㄦ	ˉ	ˊ	ˇ	ˋ			

Count: 41

Simplified Chinese characters (简体字 - jiǎntǐzì)
万 与 丑 专 业 丛 东 两 严 丧 个 丰 临 为 为 丽 举 么 义 乌 乐
Traditional Chinese Characters (繁體字 - fántǐzì)
萬 與 醜 專 業 叢 東 兩 嚴 喪 個 豐 臨 為 爲 麗 舉 麼 義 烏 樂

Count estimates range from 6,000 to 80,000.

Figure 11. *Representative non-keyboard symbols for Chinese.*

language academically or are native language speakers in China, Taiwan, Hong Kong, or Singapore (each of which presents specific complexities). However, once a set of useful observations is winnowed from those available—and appropriate analyses and inferences made—a number of unique opportunities present themselves:

- An elegant Chinese input method has the potential to invert the current **input efficiency deficit** between Chinese and English.
- Pedagogical tools based on the distinctions inherent in the input method have the potential to shorten learning curves for the written (and to some degree, the spoken) language itself.

In general, the specific arrangement of observations about Chinese determined to be useful in the development of 舞中文 ('WǔZhōngWén')—MindStride's Chinese input method—reduces complexity by an order of magnitude moving from words and phrases to (especially, keyboard) gestures[17]:

1. Each of **many tens-of-thousands** of common multi-character words and phrases begins with a single character from among **several thousands**. The number of words and phrases beginning with a particular single character is generally **very few tens**.
2. Each of the **several thousands** of individual Chinese characters—when used in context—is pronounced with one of **several hundred** unique syllables (if tone is ignored a **very few hundred**). The number of individual Chinese characters with a particular syllabic pronunciation is generally **very few tens**.
3. Each of the **several hundred** unique syllabic pronunciations for Chinese characters begins with one of **very few tens** of (approximately twenty) initials, participates in one of **very few tens** of (approximately twenty) rhymes, and has one of **five**

tone values. The number of syllabic pronunciations for a particular initial or rhyme is generally **very few tens**.

4. Most of the **approximately twenty** syllabic initials (and all of the **five** tone values) are readily associated with keyboard symbols. Most of the **approximately twenty** syllabic rhymes are *not* readily associated with keyboard symbols.

Inferences related to these observations, taken in reverse order, are suggestive and can be taken as input method design goals; it should be generally possible to:

1. Specify a pronunciation with two gestures,
2. Specify a character with a single additional gesture from the pronunciation, and
3. Specify a word or phrase with an optional second single additional gesture from the character,

with each gesture (e.g. keystroke, mouse selection, chord) being selected from a small set.

Applying art and science makes these theoretical design goals practical by user friendly presentation of choices and associations of gestures leading to selection of pronunciations, then characters, then words or phrases.

The central issue in designing for users is the balancing of immediate ease of use with what must be learned for long-term productivity gains. The most salient example in 舞中文 is specification of the syllabic pronunciation with two keyboard gestures: short-term learnability is gained via mnemonic keyboard mappings for syllabic initials (and optional tones, if used), but long term productivity is achieved via learned portmanteau associations of single keys with entire syllabic rhymes where other systems require multiple (but more mnemonic) keys. The learning curve is mitigated by there being only 20 or so non-intuitive portmanteau keystrokes to learn.[18]

By reducing selection of most Chinese words and phrases to four reasonably readily learned gestures, words and phrases can be selected in fewer keystrokes than required on average for English (assuming the average word in an English typed document is between 5 and 7 letters). It is intriguing to speculate that—once the learning curve is climbed—it may be faster to type Chinese than English.

A side note: MindStride is developing a training game that quickly steps users through learning the keys associated with mandarin syllabic rhymes as well as (we hope) making it engaging to rapidly develop motor memory for gesture sequences associated with common characters, words, and phrases. Although further research is necessary, in discussing the game design with Chinese language teachers, we determined that (1) using rhymes instead of individual (e.g. pinyin) letters may be beneficial in rapidly learning standard pronunciations with fewer errors and (2) teaching gesture sequences associated with common characters, the first two of which indicate pronunciation, may have benefits toward character memorization in general. If these results are borne out by further research, then MindStride input methods may be valuable not only as input tools, but also as additions to language teaching curricula.[19]

	Keys	Ratio	Meters
English	101	1	0.25
Spanish	121	1.20	0.30
Viet	225	2.23	0.56
Euro	609	6.03	1.51
Japanese	6000	59.41	14.85
Korean	13066	129.37	32.34
Chinese	50000	495.05	123.76

Figure 12. *Estimated physical length of keyboards for various languages.*

1 A publication and revision history of this document is available on request. Please contact the author at *MindStride@gmail.com* or *dmailman@rice.edu*.

2 Throughout the paper, the term 'emic' is used in its popular sense to indicate something that makes sense to a native speaker and is 'intuitive', rather than its related, but technically more accurate, linguistic meaning.

3 E.g. Japanese (four scripts): Kanji, Hiragana, Katakana and Romaji.

4 The first objection to using input-set-specific keyboards to reduce input efficiency deficits is the increasing tendency for users to require more than one input set. For example, there are keyboards available for the Spanish language that associate keys with its non-(QWERTY)-keyboard symbols. If an additional language—even English—is required, any input efficiency gains due to the keyboard are negated. The other obvious objection is that for many input sets, a keyboard is simply impractical. If the input method problem reduced to making a keyboard for each input set, the result would be keyboards of the lengths indicated in **Figure 12**.

5 Most modern operating systems (e.g. Linux, Windows, and Macintosh OS X) have input methods for non-English languages; and it is these that we use to estimate productivity gaps. There are many resources that can be read for background on input methods; three suggestions (thanks to Arle Lommel) are Cahill (2003), O'Hagan and Ashworth (2002) and Lunde (1999).

6 'Fewer gestures' has two meanings: (1) Fewer junctures in the sequence leading up to an input and (2) Fewer choices at each juncture in a sequence.

7 Many thanks to Diane Campbell, the co-inventor of Press & Hold.

8 Indeed, we view 31 as the upper limit of the number of simultaneous choices from which a user can quickly learn to choose with anything approaching reasonable speed (speed of learning as well as speed of selection).

9 Pinyin initials are a good example: should keyboard mappings be presented in alphabetical order, physical layout order, BPMF order, corpus frequency order, or dictionary frequency order?

10 A stroke is the diacritic that occurs in **đ**; other terms are illustrated in **Figure 6**.

11 'First Tone' is indicated by no mark on the vowel.

12 As nearly as we can tell, the 500+ characters listed, together with the common keyboard characters, comprehensively account for the following languages: Afrikaans, Basque, Breton, Catalan,

Coptic, Croatian, Czech, Danish, Dutch, English, Esperanto, Estonian, Faroese, Finnish, Flemish, French, Frisian, German, Greek, Greenlandic, Hungarian, Icelandic, Irish, Italian, Latin, Latvian, Lithuanian, Maltese, Norwegian, Polish, Portuguese, Provencal, Rhaeto-Romanic, Romanian, Romany, Sami, Slovak, Slovenian, Sorbian, Spanish, Swedish, Turkish, Welsh and a few others. Please email me if you find something missing for any of these languages or if another language should be added to the list.

[13] In input methods, we generally elect to leave out blended letters that are composed of two simple keyboard characters because they can be input by typing the letters individually (a skill already developed by average, educated users).

[14] Some characters in the table appear to be duplicates, but are in fact treated differently by different productivity applications, so dLinguist enables input of both. One example is the characters:
Đ (Unicode #0110, 'Latin capital letter D with stroke') in Croatian, Sami, and Vietnamese
Ð (Unicode #00D0, 'Latin capital letter eth') in Icelandic, Faroese, Old English, and IPA

[15] Given the nature of the problem it seems unlikely that a corpus can be identified to make it possible to do the analysis to determine which variations occur most frequently across languages or are most frequent across users. Please email me if you have any suggestions as to how these may be accomplished.

[16] The title is paraphrased from Thomas Edison's comment on invention: 'Opportunity is missed by most people because it comes dressed in overalls and looks like work.'

[17] Secondary information—useful in defining an order for presenting characters associated with pronunciations—takes the form of character frequency lists. Information regarding the visual components of characters is ignored.

[18] It should be noted that for any device other than a keyboard, 舞中文 requires no long-term learning curve and reduces the number of gestures per word or phrase dramatically.

[19] Please email me if you have an interest in, or suggestions for, researching MindStride input methods' or training games' efficacy as a pedagogical tool.

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DEFINING THE LIMITS OF ‘HARD SCIENCE’ LINGUISTICS

Robert Orr

(Molesworth) …maths hav become what every keen maths master tell you it can be i.e. a LANGUAGE.

In my view this is just another of those whopers which masters tell i mean can you just imagine peason and me at brake:

molesworth: (taking a hack at the pill) x^2 x y^6 = a
peason: z^8 - x^3 = b
molesworth: (missing completely) O, y^{99}!
As you see it simply will not do…

(Jennings) ‘Sir, Sir, please Sir’
‘Yes, Jennings?’
‘Is maths a language, Sir?’
‘Well, yes, in a way, Jennings, it’s a sort of way of symbolising things.’
‘Oh really, Sir? How do you say “Good morning it’s a lovely day” in Algebra?’
‘You silly little boy!!!!! You can’t say things like that!!!!!!!!!’

BUT

‘That is not to say that [Chinese] is disabled, or that certain things “cannot be said” in Chinese. Nobody would use it if this were so’.
(Newnham 1971:22)

1. Whence, where, and whither linguistics? The issue of the very position of linguistics within scholarship periodically gives rise to a great deal of discussion, scholarly and otherwise. This even surfaces within university administrations, where the faculty in which a given university’s linguistics department is located varies from institution to institution, usually between faculties of Arts and Social Sciences. Wescott (2000:252) notes that European universities tend to locate departments of linguistics in the humanities, while American universities tend to locate them with the social sciences. Currently there is even an ongoing attempt to move linguistics into the ‘hard’ sciences (mathematics, physics, etc., see the articles in Yngve & Wąsik, eds. (2004), and the literature cited therein), which would probably involve the transfer of linguistics to faculties of science if successful. This lack of

agreement as to the nature of linguistic research also turns up on the diachronic as well as the synchronic level; Thorne (1965:74) points out that the student who learnt transformational linguistics in the 1960's was learning a different subject from the student who had learnt structural linguistics in the 1940's and 1950's, see also Derwing (1973:25, passim).

2. 'PHYSICS ENVY': MATHEMATICIANS AND PHYSICISTS VS. 'STAMP-COLLECTORS'. Physics has been dubbed the 'Queen of Sciences', and certain eminent physicists have allowed themselves to come across as disdainful of other branches of research, leading to an attitude that might be dubbed arrogance. The pronouncement, normally attributed to Lord Kelvin, that, 'in science there is only physics; all the rest is stamp collecting,' is well known, and often cited.[1] In the same vein, Gould (1991:281) quotes Luís Alvarez[2] in the *New York Times* as follows: 'I don't like to say bad things about paleontologists, but they're really not very good scientists. They're more like stamp collectors', echoing Lord Kelvin. A large number of linguists and biologists appear to be unsure of the status of their fields as a science, and to have internalized such criticism, which has given rise to the term 'physics envy'.[3] This phenomenon might be linked to a similar disdain expressed for fieldwork in both linguistics and biology, which may be traced back to 'theory' being accorded higher status than basic research, and low status accorded to fieldwork in both areas, see, e.g., van Driem (2001:76), passim, although he does not use the words 'physics envy'. Neither does Dixon, although he (1997:128–38) decries the apparent situation in modern linguistics, where 'theory' is accorded higher status than basic research:

> ...one major myth... [is that]... There are essentially two types of linguist. The descriptivists, who do field work and write grammars. And the theoreticians (i.e., the formalists, people working on non-basic theories), who do not gather data themselves but rather interpret it, from the point of view of their chosen formalism. The myth is that the work done by the 'theoreticians' is more difficult, more important, more intellectual, altogether on a higher plane than the basic work undertaken by the descriptivists.[4]

This is echoed by Quammen (1996:482), quoting Simberloff, who actually does use the term 'physics envy', suggesting that it has played a harmful role in certain specific instances, e.g., measures to conserve small jaguar and harpy eagle populations in Costa Rica, and tiny nature reserves in Israel:

> It's sad. There's an element of physics envy in all of this... That's what is really at issue here... In order to be heeded in the councils of policy, some ecologists believe, they've got to deliver deductive conclusions in concise mathematical form. And it's too bad, but ecology isn't that kind of science.

Unfortunately, it might be said that certain scholars outside physics, especially linguists and biologists in this context, have internalized some degree of 'physics envy'.[5]

Emotions akin to 'physics envy' have also been expressed in linguistics. Advocates of formalist approaches to linguistics often give voice to charges that more traditional linguistics is merely 'anecdotal'. In fact, in the heyday of Generative Linguistics its practitioners often suggested that one of its main aims was 'to move linguistics beyond a stage of being merely anecdotal'. This paper is an attempt to examine ways in which such attitudes, specifically 'physics envy', might be countered.

3. THE RANGE OF LINGUISTIC RESEARCH. Firstly, attempting to stake out a place for linguistics within the sciences, therefore, or even within the range of human scholarship is a difficult task. It is a commonplace that the disciplines commonly referred to as the 'Sciences' may be grouped as follows:

> mathematics > physics > chemistry (inorganic/organic)[6] > biology/ecology

where the mathematician researches premises that the physicist takes for granted, the physicist researches premises that the chemist takes for granted, and the chemist researches premises that the biologist takes for granted.

Language, however, spans a similar range of fields within itself:

> phonetics (acoustic/articulatory) > mor(pho)phonology > syntax > semantics > literary criticism, poetics, etc.,

One indicator of the problems in pushing parallels between language and physics/mathematics too far may be found by comparing the second epigraph to this paper (Jennings) and the third (Newnham) given above: mathematics may be viewed as essentially a closed system for symbolising a *finite* number of relations, whereas any naturally evolved human language, in this case Chinese, may be used to express an *infinite* number of concepts, limited only by the imagination. This is parallelled by the scholarly range of fields covered and touched on by linguistics; Wescott (2000:252)[7] points out that within linguistics acoustic phonetics is closest to physics,[8] and articulatory phonetics to biology.

At the far end of the scholarly spectrum from acoustic phonetics is semantics, which shades into several fields of study, e.g., philology, poetics, etc. Puhvel (2003:349) cites an interesting example from Hittite poetry, which provides evidence for previous extensive forest cover in Anatolia, and concludes that, 'philology can capture what is poetic in the patrimony of vanished peoples and cultures'; see also the discussion in Orr (2005:416–17), for additional citations of evidence from linguistics and related fields, e.g., onomastics, where place-name studies can recapture evidence of extinct animals, rates of extinction, or replacement.

Furthermore, much about language may seem arbitrary to those accustomed to the rigors of mathematics or physics. An excellent example is the phenomenon where linguistic relationships are guessed at on the basis of one feature, or where one feature defines a language in the eyes of its immediate neighbors. Examples which may be cited include the attitude of English and French-speakers to the voiceless velar fricative, absent in most

varieties of English and French, which is a salient feature in English-speakers' respective perceptions of German, Scots, Welsh, and Gaelic, and French-speakers' perceptions of German and Breton, leading to all sorts of surmises about relationships.

Amerindian languages with voiceless laterals, perceived as very prominent in Welsh by English speakers,[9] may have been instrumental in the popular eighteenth-century myth of Welsh-speaking American Indians, especially, e.g., Mandan, as well as some in British Columbia, partly on the basis of this shared phoneme, were believed to be related to Welsh by early settlers in North America.[10]

This overall phenomenon, which has to be taken into account by the well-rounded linguist, may be related to a comparable one in literary criticism, where characters in novels are often introduced and then cited by highlighting one prominent feature in their appearance. This device was especially common in the works of Tolstoy, see de Haard (1979, 1990).

Therefore one might include literary criticism among the fields touched on by linguistics, as listed by Wescott (2002:252), extending its range yet further, which, again poses problems to scholars who wish to include linguistics among the 'hard sciences'.

It has been suggested that compared to the 'hard' sciences, linguistics is still in a 'pre-Galileo stage' (see, e.g. Yngve 2004:104–5). Nevertheless, the progress of human knowledge should not be viewed in a straight line. The fact that fallible humans are involved in 'doing hard science' has introduced errors and irregularities into the field. The career of Galileo himself is indicative: his accumulation of knowledge and reason did not move in a straight line, culminating in his famous dispute with the Inquisition, but included its fair share of dead ends, errors, and retreats. One incident in particular should be noted: about fifteen years before Galileo's better-known confrontation with the church authorities he was involved in a dispute over the nature of comets. The Jesuit astronomer Horatio Grassi declared them to be real material bodies moving in the celestial region beyond the moon, while Galileo held that they were 'atmospheric phenomena'.

In any case, however, caution should be exercised in automatically ranking 'hard sciences' above 'soft' sciences. The 'hard sciences' are still, when all is said and done, practiced by fallible humans. In fact, Wallace (2005:67–68, 94, 120, 157, 184) recalls that it was Lord Kelvin himself, who insisted that the earth had taken only 100 million years to cool, based on the physics available to him at the time. Fortey cites a further example where the use of data from the so-called 'soft' sciences (paleontology) prompted a rethink of a theory based on data from the 'hard' sciences: paleomagnetism. The Earth's poles regularly change position, and paleomagnetism involves reading ancient rocks to determine their former position, which, involving precise measurements of levels of magnetism is superficially a 'harder' science than paleontology, with its gaps, imperfect records, etc. Therefore when the distribution of trilobite fossils and paleomagnetic data appear to point to different locations for the positioning of Avalonia (an Ordovician microcontinent consisting of modern England and Wales plus Eastern Newfoundland), the normal instinct would be to accept the conclusions suggested by the paleomagnetic data. Fortey however, shows that, in this instance, insisting on the accuracy of the data from the fossil distribution prompted a reanalysis of the paleomagnetic data, which were later shown to have been faulty (2001:188–89, 197–98).

We might conclude this section by citing Bertrand Russell: 'Physics is mathematical *not* because we know so much about the physical world, but because we know *so little*; it is only its mathematical properties that we can discover' (emphasis added).

4. LAWS – MATHEMATICS, PHYSICS AND LINGUISTICS. All areas of scholarship, not only sciences or quasi-sciences, make use of the term 'law' for phenomena that they seek to explain, and linguistics is no exception. One difference between laws in linguistics and those in the 'hard' sciences was noted in passing by Dmitriy Mendeleyev well over a century ago: Mendeleyev shied away from the word 'law' [*zakon*] and called it [the periodic system] a 'regularity' [*pravil'nost*], later to return to using the term 'law' (see Gordin 2004:31).

In a later edition (1889), however, Mendeleyev was firmer: 'The laws of nature do not tolerate exceptions, *and this differentiates them from rules and regularities, such as, e.g., grammatical ones*' (emphasis added) (see Gordin 2004:184).

The same point was made in more detail by Wright (1907:1):

> In applying the term 'law' to the phenomena of sound-change, it is of great importance to understand that the term is used in a technical sense and must never be confounded with the use of the term 'law' as applied to the physical sciences, such as physics, chemistry, &c.
>
> Physical laws lay down what must invariably and always happen under certain given conditions, whereas sound laws merely state the regularity of sound-change observed in any particular group of historic phenomena… Physical laws are absolute and unchanging. They operate to-day just in the same manner as they did in all past ages, and will continue to do so for all time to come… [they have] held good and will hold good for all times and all places.
>
> But not so with sound laws. In treating of the history and philology of any language or groups of languages, two of the most important points, which the investigator carefully observes, are chronology and geography. Sound laws only operate for a limited period and then cease to operate, and their operation is confined to a small area.

In this context a further difference should be noted. Comrie (1981:5–12) contrasts the analyses of '…the chemical properties of iron' and 'human behavior under stress', pointing out that in the former instance we can glean all our information from one sample of iron, whereas in the latter we would need to observe several individuals and analyze their behavior. He goes on to argue convincingly that language is analogous to the latter case rather the former.

Again, the 'laws' of linguistics are generally far too intricate to be easily equated with the laws of 'mathematics' or 'physics', and linguistics itself is far too intricate to be crudely described as 'mathematical'. Frequently such laws can best be described as regularities, or tendencies.

One area where language actually does seem to be 'mathematical', however, may be glimpsed in the canonical, fairly widespread SOV (Subject-Object-Verb) word order pattern, as exemplified by constructions attested in Turkic, Dravidian, Japanese, e.g.,

(1)	S (A (+ N))		O (A (+ N))		V	
	A	N	A	N	V	
	güzel	*kız*	*güç*	*kitabı*	*okudu*	(Turkish)
	'the pretty girl read the difficult book'					

SOV word order implies a host of other features, and knowledge of the SOV pattern in, e.g., Turkic, allows one to map the pattern onto, e.g., Dravidian for language-learning purposes.[11] One such apparent correlation is that adjectives precede nouns. And yet Farsi is often classified as canonical SOV, and yet in that language nouns precede adjectives, e.g.,

(2)	S (N	(+ A))	O (N (+	A))	V	
	N	A	N	A	V	
	dokhtar-i-khoshgel		*kitab-i-sakht-ra*		*khand*	(Farsi)
	'the pretty girl read the difficult book'					

Furthermore, for most of the nineteenth century, developments in Indo-European (IE) linguistics appeared to point more and more clearly to an underlying regularity in language evolution which for a time appeared to be closer and closer to discovery, and which was expected to impart more rigour to linguistics, moving it ever closer to the 'hard' sciences. When Grimm's Law was first formulated (accounting for the first Germanic (Gmc) sound shift; IE **p* > Gmc **f*; IE *t* > Gmc **þ*; IE **k* > Gmc **χ*, etc.) in the early 1800's, several apparent accompanying irregularities were accepted or glossed over. Later on in the century, however, especially the 1860's and 1870's, there were several important steps forward in the development of linguistics as a field, all involving the revealing of hitherto unsuspected regularities.

First there was Grassmann's Law, which demonstrated that adjacent syllables had to be considered in reconstruction, see Collinge (1985:47–61), e.g.,

(3)	Sanskrit	***bodh****(ayati)*	***Buddha***	}	< IE ****bhoudh****- / *bhudh-*	'awaken'
	Old English (Gmc)	***bēod****an*	*ge****bod****en*	}		'announce'

Then came Verner's Law, which demonstrated that accentuation had to be considered in reconstruction, see Collinge (1985:203–16), e.g.,

(4)	Sanskrit	***várt****ate*	*va****várta***	*va****vrt****imá*	*va****vrtānā***	}	< IE **vért-/vrt-'*	'turn'
	Old English (Gmc)	***weorþ****an*	***wearþ***	***wurd****on*	***word****en*	}		'become'

Verner's Law and Grassmann's Law are particularly noteworthy in that they revealed hidden regularities where previous investigators had seen, and cheerfully accepted, irregularities.

The cumulative effect of such discoveries was to lead to the formulation that sound-laws had no exceptions, thus apparently adding far greater 'scientific' rigour to linguistics.

They were followed closely by the Law of Palatals, see Collinge (1985:133–42):

(5)	Sanskrit	***ca**tuh* }	< IE **k^w etur-* 'four'
	Lithuanian	***ke**turi* }	

which demonstrated that the Sanskrit merger of IE **e*, **a*, and **o* represented an innovation. The cumulative effect of such discoveries was to boost the rising Neogrammarian School, who felt confident enough to formulate the overarching law that linguistic 'sound-laws have no exceptions', thus apparently adding far greater 'scientific' weight to linguistics.

Nevertheless, the development of historical linguistics and reconstruction did not continue to proceed in the direction of ever-greater scientific rigour. Vermeer (2003:398) suggests that such a scholarly atmosphere gave rise to a situation where scholars

> ...started scouring the landscape for hidden regularities that might immortalize their name. For all they knew, their very own sound law could be waiting just around the corner. The pace of discovery quickened. Matters of priority came to occupy more attention that at any time before or since.

One phenomenon where the Neogrammarians came to grief was the Common Slavic sound change conventionally dubbed the Third Palatalization, which may be formulated approximately as follows:

(6) **k* > *c*, **g* > *dz*, **x* > *s*/*š* /i_V[-hi], e.g.,

**k* > *c*	Czech *ote**c***	<	**ătĭ**k**ăs*	'father'
**g* > (*d*)*z*	Polish *ksią**dz***	<	**kŭnę**g**ăs*	'priest'
**x* > *s*/*š*	Russian *всё* }	<	***vĭxă***	'everything'
	Czech *vše* }			

However, the Third Palatalization is by no means as regular as other sound changes in historical linguistics. It is more consistently carried through in some parts of Slavic than in others (as a general rule, more consistently in South-West than in North-East Slavic), and doublets occur, e.g., Russian *отец* ('father')/*отёк* ('father, dialectal') < **otĭcĭ*/*otĭkŭ*, both from **ătĭ**k**ăs*. For more than a hundred years it has been the subject of attempts at ever more subtle refinements by various scholars, although the broad outlines have been known for at least a century (see Vermeer 2003 for details). Again, the Third Palatalization may be seen as an excellent example of a tendency rather than an actual exceptionless law, and as illustrating the difficulties applying the methods of the 'hard sciences' to many areas of linguistics.

5. PREDICTIVE POWER – HISTORY – DIAMOND'S FRAMEWORK. The whole concept of 'physics envy' is successfully turned around by Diamond (1997:420–25), who argues

that the 'historical sciences' have far less apparent explanatory power than fields such as mathematics and physics simply because of the vast number of variables that have to be taken into account.[12] Shermer (2002:320–23) takes up Diamond's point (see below; disappointingly, in spite of titling his subheading 'the comparative method', Shermer hardly mentions linguistics), calling it a 'superb piece of scientific history, applying the comparative method and using evolutionary thinking', and concludes by saying that historians and biologists (although I would add linguists) 'may have to work a lot harder than physicists and astronomers in isolating our variables and testing them, but test them we must'.[13] He points out that Diamond has managed to synthesise a falsifiable theory of history, by applying elements from genetics, molecular biology, behavior ecology, and biogeography, showing that societies develop first by domesticating animals and grains, followed by the development of agriculture, writing, metallurgy, advanced forms of government and warfare, larger populations, etc. He cites a telling example of how Diamond's theory might be falsified (2002:322): 'If historians discover that Native Americans had an elaborate writing system and advanced metallurgy, yet never developed a correspondingly complex system of farming and domesticated animals, his theory would be doomed'.[14]

However, Diamond's theory is still very far from providing the same level of explanatory power as theories in mathematics and physics. Two parallels from linguistics might be cited, from numerous unidirectional typological theories that appear to have universal scope. Although these frameworks do appear to have some degree of predictive and explanatory power, they fall far short of mathematics and physics in this regard.

5.1. NEOTENY. This approach is mainly associated with Bichakjian, who in a number of works has argued strongly in favour of the theory that language can be seen to be evolving unidirectionally. His 1996 article provides a good summary of his views. He borrows the concept of *neoteny* from biology (the retention of juvenile features by adults), and proposes that the unidirectional changes which he reconstructs "*...have been produced by a process which consist of replacing late-acquired linguistic features with ever-earlier acquired alternatives*' (1996:160; emphasis in the original) and:

> ...the vernaculars of Africa, America, and Australia, and the standardised languages of Europe and Asia, may all have travelled slightly different paths, though in fact many of the shifts are shared... and the remaining differences are often consistent with the prevailing evolutionary phases... but everywhere the trend has been towards earlier-acquired features... all human languages have under normal circumstances have evolved in the direction of earlier-acquired features. (1997:39)

He concludes his 1997 article by attempting to synthesise language evolution and human evolution, suggesting that:

> ...an increasingly early acquisition has manifold selective advantages, language evolution emerges as an optimisation process, possibly produced by the same genetic mechanisms that explain the neotenous evolution of human morphology and

> ethnology. If this probability is confirmed, the evolution of human language and the evolution of humankind would become homologous processes. (1997:41)

Beaken, however, points out that loss of complexity in one area of a language is often balanced by increased complexity in another. He cites the contrast between the loss of case in English and the development of subordinate clauses (1996: 154-155). McNamara and Long (1998:94, 190–201, 232–34, 246–53) contribute a series of extensive, valuable discussions on neoteny in biology, citing examples from the evolution of insects, dinosaurs, humans, horses, and brontotheres. They point out that evolution often progresses through forms either accelerating or slowing down parts of their growth. In this way neoteny/paedomorphosis be an important driving force behind evolution. It would certainly be a desideratum if this sort of thinking could be integrated into Bichakjian's work, as there are certain recalcitrant examples which do not seem to fit.

5.2. CONTENT-ORDERED TYPOLOGY. Another comparatively recent theory of unidirectional linguistic development is that proposed by Klimov. In a series of works (1977, 1983) he proposes that there is a well-defined path along which linguistic structures may be seen to evolve, which he names 'content-ordered typology' (*контенсивная типолгия*), according to which languages with a typology based on *noun classes* will develop into *active* languages, which in turn will develop into *ergative* languages, and then into *nominative/accusative* languages. For a useful summary, and some criticism, of the main points of Klimov's work see Nichols (1992:7–12).

6. CONCLUSION. The thrust of this paper might be summed up with another citation from Diamond: 'But remember that the word "science" is not derived from the Latin word for "replicated laboratory experiment", but instead from the Latin word for "knowledge" (1998:62).

It has been argued throughout this paper that efforts to make linguistics into a science in the sense of 'replicated laboratory experiment' are misguided, citing evidence from the scope of the field(s) normally understood by the term 'linguistics', the difference between 'laws' in linguistics and those in mathematics and physics, and the different degrees of predictive power. But neither must we fall into the trap of assuming that linguistics is entirely unscientific - there is some degree of overlap, albeit only partial; as argued above, linguistics does have many features in common with the 'hard' sciences. More important, if linguistics is successfully moved into the 'hard sciences', a great deal of interesting 'nonscientific' material may be ignored and neglected. Nor is it even clear that mathematicians and physicists would accept 'hard science' linguistics as a science, despite the best efforts of advocates of 'hard-science linguistics'.

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1 Tracking down Lord Kelvin's exact words and the source, may be a topic for another article. An Internet search reveals that the very similar wording ('All science is either physics or stamp collecting') may also be attributed to Baron Rutherford, cf. Gould's citation of Luís Alvarez.

[2] Paradoxically, in view of his remarks about paleontologists, in the context of his theory that a layer of iridium in the earth's crust can be used to date the extinction of the dinosaurs.

[3] 'Physics envy' might equally be dubbed 'mathematics envy', and in this paper both meanings will be subsumed under the heading 'physics envy'.

[4] 'Learning without thinking is useless. Thinking without learning is dangerous' (Confucius, Analects ii. 15). See also Quammen 2003:67–68 for a similar scenario from the field of zoology in the 1920's, which reads strangely parallel to Dixon's complaint.

[5] The concept of physics envy turns up in unexpected places. The Ludwig von Mises Institute (http://www.mises.org/quiz.asp) runs a questionnaire which includes the wording:

> Like the physicist, the economist (*if he wants to be scientific*) should construct a precise model that yields quantitative predictions about economic variables, such as GDP and unemployment. (emphasis added)

Physics envy has even been blamed, e.g., for some of the problems in Britain's National Health Service (Tim Hames, *The Times* October 25, 1999).

[6] William Sullivan [p.c] points out that a similar demarcation line within the sciences may be drawn between inorganic and organic chemistry.

[7] It is interesting to note that some library classification systems have taken this into account, e.g., the Library of Congress system classifies linguistic subfields thus: phonetics (P/Q) > mor(pho)phonology (P) > syntax (P) > semantics (P), where the general heading Q subsumes science, and P language and literature.

[8] As far as I can judge, Yngve and Wąsik (2004) is focused mainly on language as a means of communication, and their attempts to move linguistics into the 'hard sciences' are based to a great extent on acoustic phonetics, the linguistic subfield closest to physics, as suggested by Wescott (2000:252).

[9] Cf. Machen, *The Novel of the Black Seal*: '...the two men... talked of philology with the enthusiasm of a burgess over the peerage. The parson was expounding the pronunciation of the Welsh *ll*, and producing sounds like a gurgle of his native brooks...'

[10] Such relationships may also be surmised on the basis of individual lexemes. For Breton, Vallerie (2003:280) points to the use of *ja* for 'yes', which led French speakers to the perception that German and Breton were closely related. Speakers of Lower Sorbian call speakers of Upper Sorbian *hajak*, derived from Upper Sorbian *haj* 'yes', and Icelanders have developed a nickname for the Faroese - *nógvarar* (< Faroese *nógv* 'much, many'), which to Icelandic ears is a salient, frequent, uniquely Faroese lexeme, although easily derivable from Old Norse *nóg*. Sometimes relationships can be surmised on the basis of single, even relatively infrequent, lexemes. Wolfe (2003:104) cites the case of John Rule, who believed that Maori was related to Norman French on the basis of French *mauve* 'seagull', which he linked, confusingly, with the word *Maori* itself. On occasion such lexemes are misinterpreted by speakers with limited linguistic knowledge. When taking Chinese courses I recall being told that there had been an elderly Chinese teacher in London who had postulated a relationship between Latin and Chinese on the basis of a perceived equation between Latin *(dom)u-s* 'house' and Chinese *u-z* 'house' (Romanized possibly according to an early version of the Yale system; cf. Pinyin *wu-zi*).

11 I had this experience when doing classes in Tamil after learning Turkish and Japanese. The teacher was a pathology lab technician who had been educated in Tamil, but had not studied linguistics. On one occasion he actually described Tamil syntax as 'mathematical'.

12 Interestingly, it might be noted that in his conversations with Quammen (1996:482). Simberloff hints that in some of his earlier writings Diamond himself may not have proved completely immune to the pull of 'physics envy':

> 'The theory that doesn't really have strong empirical support can be very dangerous'. In the dangerous class [Simberloff] includes… Jared Diamond's reserve-design principles… Theory in any branch of science entails a risk of detachment from reality, but especially so in a science as multifarious as ecology. If the theory is applied in decision-making that affects how humanity treats portions of the world's landscape, the risks and the consequences are still greater. It's not like, at worst it's neutral. At worst, it's *bad*.

13 In her conclusion to an analysis of manifestations of agency in Polish Tabakowska (2003:399–400) cites, echoing Diamond (1997:420–25) many of the difficulties involved in trying to allot too great an explanatory power to linguistic theories and frameworks :

> …the ever-growing list of arguments, which come from different areas of different languages and make theorists of language give up the generativist dream about full formalization and perfect predictability of grammatical constructions. It is now obvious to most that models of natural languages which postulate unconditioned discreteness of linguistic categories are too simplified to (not to say simplistic) to provide satisfactory descriptions of anything but selected samples of presanitized or artificial data. Pragmatic features have to be taken account of, and introducing the 'human factor' necessarily turns deterministic rules into probabilistic principles. On the other hand it allows for subtler distinctions that make possible more comprehensive interpretations and more complete descriptions.

14 Complicating the issue further, however, Jacobs (2005:11–26) offers a discussion of Diamond's framework, and then goes on to point out that Diamond has only considered one side of the equation, the winners, and that his framework should also include factors identifying the losers as well as the winners. She points out (2005:20), more succinctly than many writers, that analysis

> …turn[s] mushy and unreliable as soon as human decisions enter… the equation… But I think he limited its explanatory power unnecessarily by the way he posed his initial Question: *What are the advantages that enable cultural conquerors to win conflicts with losers?*

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AN ARTIFACT OF THE DESCRIPTION: THE GOOD AND BAD OF AN OT APPROACH

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One of the questions frequently asked of and by American structural linguists in the pre-Chomskyan era was whether a particular facet of a linguistic description was actually a part of the structure of the language or an artifact of the description imposed by the linguist. The question is no longer asked, but it should be. The family of theories known under the rubric of transformational-generative theory (hereafter C-linguistics) produce descriptions which often exhibit artifacts characteristic of one or another of the assumptions of the parent theory. Several of the newer C-linguistic theories have produced findings which are likely to endure in some form. But even they exhibit artifacts of Chomsky's parent theory. The present study deals with such a situation involving Ukrainian phonology and Optimality Theory.

The post-palatal fricatives in Ukrainian present problems for both historical and synchronic phonology. It is generally accepted that the recension of Proto-Slavic */g/[1] in contemporary Ukrainian is a voiced fricative. The synchronic description faces two problems. First, the voiced post-palatal fricatives may be dorsovelar or pharyngeal, but their distribution is complementary. The unvoiced fricative shows no such allophones, being generally dorsovelar. This is troubling because of the lack of symmetry between the voiced and unvoiced, something unique in Ukrainian phonology. It is also troubling because of morphophonemic alternation, which always results in a frontopalatal fricative, making the morphophonemic rules difficult to state.[2]

The historical problem involves dating the frication. It would be convenient to date frication before the first palatalization of velars to account for the fact that the product is also a voiced fricative, unlike the affricates that arose from the palatalization of */k/. But the results of the first palatalization are common Slavic, and the frication of */g/ is restricted to Ukrainian, Belarus, Czech, Slovak, and Serbocroatian. Presumably, if the frication were that early, it should have spread throughout the Slavic family (but see Orr 2005).

The present study was inspired by Czaplicki 2001 and the Optimality Theory (OT) description of Ukrainian post-palatal fricatives given therein, along with the criticism of his work given by C-phonologists[3] present. However, Czaplicki has generously provided me with a more complete, revised description (Czaplicki in press) that is the takeoff point for the present study. The main feature of the criticisms had to do with the underlying representation, which Czaplicki identifies as [γ]. I show that the problem derives from C-phonological (not OT) postulates and that a relational network (hereafter RN) description provides all the proper results without falling in the problematical traps. In

[γ]	boγ	'god, Nsg'	druγ	'friend, Nsg'		
[γ']	γ'ist'	'guest, Nsg'	γ'irka	'hill'	γ'irš	'worse'
[H]	boHa	'god, Gsg'	druHa	'friend, Gsg'		
[H]	Host'a	'guest, Nsg'	Hora	'mountain'		

Table 1. *The voiced post-palatal fricatives of Ukrainian.*

[x]	pux	'down'	mux	'fly, Gpl'		
	xata	'cottage'	muxa	'fly, Nsg'	xoda	'walk, Gsg'
[x']	arx'iw	'archives'	x'irt	'greyhound'	x'id	'walk, Nsg'

Table 2. *The unvoiced post-palatal fricatives of Ukrainian.*

Gloss	Nsg	Gsg	Voc
God	boγ	boHa	bože
Czech man	čex	čexa	češe

Table 3. *Substitutive softening in Ukrainian nominal declension.*

turn, this shows that the problems are merely an artifact of the theory underlying the descriptive model.

I begin with the phonetic facts and an outline of the OT approach before presenting Czaplicki's description. I continue with a RN description and conclude with the theoretical implications.

1. POST-PALATAL FRICATIVES IN UKRAINIAN.

1.1. THE PHONETIC FACTS. Ukrainian has five phones which are post-palatal fricatives, three voiced (pharyngeal [H], dorsovelar [γ], and palatalized (soft) dorsovelar [γ']) and two unvoiced (dorsovelar [x] and soft dorsovelar [x']). The five phones can be grouped into two phonemes distinguished on the basis of voice.

Examples of the voiced phoneme are given in **Table 1**. Examples of the unvoiced phoneme are given in **Table 2**.[4]

Note that the alternation between [o] and [i] is regular in Ukrainian. Its appearance here is ignored, except for its effect on the post-palatal fricatives. Note also that Czaplicki actually works in Derivational Optionality Theory (DOT), which accepts a level of derivation (cf. Rubach 2000). As a result, the added problem of morphophonemic alternation arises. Consider the examples in **Table 3**.

1.2. A NEO-BLOOMFIELDIAN DESCRIPTION. As mentioned above, the contrast in post-palatal fricatives hinges on the opposition voiced-unvoiced. The actual place of articulation is predictable from the location of the phone in the syllable: soft variants occur only in onset position before [i], voiced velars occur only soft or in syllable coda position, and the pharyngeal occurs in onset position before vowels other than [i]. These facts are summarized in **Table 4**.

position	Onset		Onset _[i]		Coda
voiced	druHa	Host'a	γ'ist'	γ'irš	druγ
unvoiced	muxa	xoda	x'id	x'irt	mux

Table 4. *The contrasts of post-palatal fricatives in Ukrainian.*

The distribution in **Table 4** produces no problems for a pre-Chomskyan phonologist. To a neo-Bloomfieldian like Bernard Bloch, the lack of symmetry in the place of articulation is just a fact and an allophone is not a phoneme. So long as mutually exclusive distribution statements can be stated, the phonemic analysis is secure, if not neat. Bloch would have grouped [γ], [γ'], and [H] into a single voiced post-palatal fricative phoneme (or spirant phoneme at Yale) with the appropriate allophonic distribution statements (as in **Table 4**). Similarly, he would have grouped [x] and [x'] into a single unvoiced dorsovelar spirant phoneme with two allophones and the appropriate distribution statements.[5] I do not deal with the morphophonemics here, since neo-Bloomfieldians treated morphophonemes as fictions. The RN description treats morphophonemes as a downward OR relation at a particular level of realization (cf. N in **Figure 1** on page 244).

Problems arise for C-phonologists. This includes people working in OT. But before looking at these problems, I present a short introduction to the main characteristics of OT phonology.

2. OT PHONOLOGY. Optimality Theory is perhaps the newest C-phonological theory to gain a fair and still growing number of adherents. It is, as remarked above, a distinct theory in the C-phonological family. This means that it accepts as axiomatic the basic postulates of C-phonology and adds postulates of its own. To present a picture of what OT owes to C-phonology and which insights it has developed on its own, I outline the two sets of premises now.

2.1. OT AXIOMS. There are four axiomatic postulates adopted from C-phonology.[6] First is the existence of an underlying phonetic form for each lexical item. Second, the phonetic form consists of a matrix of binary features. Third, the features are read off a symmetric feature tree according to the feature geometry hypothesis (cf. Halle 1992, following Sagey 1986).[7] Fourth, the overarching principle here is the universality of all these C-phonology postulates. These postulates constitute the relevant axioms of OT.[8]

2.2. OT POSTULATES. The postulates specific to OT concern input-output (IO) relations involving phonetic form. More properly, they concern the IO relations between underlying and surface form. The primary OT postulate is that there are constraints on the set of possible constraints and list the violations, excepting only phonetically or phonologically impossible forms, e.g. a soft (palatalized) pharyngeal. There are two types of violations: fatal and non-fatal. A fatal violation presumably disqualifies an output form, unless no output form exists without a fatal violation.[9] The winning form is the one with the violation of the lowest-ranking constraints. If two potential output forms violate the same constraints,

1.	No Onset-γ ([γ] cannot appear in syllable-onset position)
2.	Pal-i (only palatalized consonants can appear before i)
3.	Ident-Pl (output place of articulation = input place of articulation)
4.	NoPl (laryngeal [sic] consonants are not assigned a place of articulation)[10]

Table 5. *Czaplicki's ranked OT constraints for Ukrainian post-palatals.*

the winner is the one that has the fewest violations of that constraint. The rank level of the constraint violated is the crucial variable.

The format of OT postulates is open to criticism on a number of grounds, but this is beyond the scope of the present study. However, one further characteristic of Czaplicki's variant of OT must be mentioned. This is his acceptance of Derivational OT (hereafter DOT). DOT incorporates morphophonemic alternation into phonological descriptions. The diametrically opposed view also exists within OT. That is an approach where all morphophonemics is accounted for by allomorphic underlying forms. But the assumption of universal allomorphy handles the alternation in non-phonological fashion. DOT is more demanding phonologically and Czaplicki works with it. I turn now to his description.

3. CZAPLICKI'S DESCRIPTION. Czaplicki in press identifies the underlying form of the unvoiced post-palatal fricative as dorsovelar //x//. This one produces no difficulties, as the difference between [x] and [x'] is predictable. The constraint called Ident-Pl states that the output place of articulation is the same as the input place. Czaplicki identifies dorsovelar as the underlying place of articulation, arguing for an underlying form of //γ// and against an underlying form of //H//. The description requires four constraints, ranked in importance as in **Table 5**. It selects all the correct output forms.

To see how this works, begin with the input form //γazeta// and two potential output forms, [Hazeta] and [γazeta], focusing on the relevant fricative. The former, [Hazeta], violates Ident-Pl once. But [γazeta] has a fatal violation of NoOnset-γ, the highest-ranked constraint, and violates NoPl once. Both potential output forms have constraint violations. But [γazeta] has a fatal violation of the highest-ranked constraint, whereas [Hazeta]'s violation is of a lower-ranked constraint. This makes [Hazeta] the preferred output form.

Now consider underlying //boγ// 'god' and test the two output forms [boγ] and [boH]. The [γ] in [boγ] evokes only a single violation of NoPl, the lowest-ranked constraint, whereas the [H] in [boH] violates the higher-ranked Ident-Pl. Thus [boγ] is the preferred form.

Finally, consider the input form //γist'// versus the three potential output forms [γist'], [Hist'], and [γ'ist']. First, [γ] in [γist'] violates NoOnset-γ fatally as well as violating Pal-i and noPl for a total of three violations. The [H] in [Hist'] violates Pal-i fatally and Ident-Pl for a total of two. But the [γ'] in [γ'ist] violates only the lowest-ranked NoPl. Ident-Pl is not violated because [γ'] is still dorsal. Only the [+ back] feature of [γ] is affected; it is replaced by [- back]. At the same time, however, [γ'] does not violate NoOnset-γ by virtue of the difference between [+ back] and [- back]: //γ// is [+ back].[11] As a bonus the statement of morphophonemic alternation can focus on the alternation in the single place feature [+ Dorsal] for //x, γ, k//.

A review of Czaplicki's reasons for rejecting underlying //H// are left to a reading of his article.

Czaplicki's original presentation was similar to Czaplicki in press, but the emphasis differed. He put more emphasis on the morphophonemic alternation, instead of presenting it as a bonus. This resulted in the unjust criticism that he was presenting a historical description. I was unable to convince the critic that this was a matter of presentation rather than the actual substance of a historical approach. The real source of the problem is a topic I return to in section 5. First I outline some advantages and some criticisms of Czaplicki's work that were not noted by his C-phonologist critic.

Czaplicki in press provides a synchronic description of a thorny problem in Ukrainian phonology and accounts for a related and productive morphophonemic alternation without reverting to phonological rewrite rules. It also distinguishes between what is phonemic and what is morphophonemic. In common with other variants of OT, his work distinguishes between the structural or phonotactic and the semiotic or realizational portions of the phonological system. That is, the constraints as IO relations are realizational and the ranking reflects phonological structure or phonotactics. For a graphic demonstration of this see Sullivan 2001 on Korean and Sullivan in press on Russian.

There are some real criticisms of Czaplicki's description. First consider the constraints. NoPl says that laryngeal (?pharyngeal) consonants have no place of articulation. I am not sure how the larynx (or pharynx) could be located nowhere physiologically, so this is not an actual articulatory designation like Labial or Dorsal. It can only be a theory-specific choice to leave the place of articulation for later specification.[12] Moreover, as a language universal it makes no sense. If any place of articulation is unspecified underlyingly and provided later, it should be apical. The apical series is generally the most numerous among the world's languages. Thus if feature-counting is important, eliminating this specification would save a lot more than eliminating the specification of pharyngeal. Another problematical constraint is NoOnset-γ. My objection here is not to the constraint itself, though it would be better stated positively. It clearly reflects a fact of the Ukrainian phonological system. Yet I object on two grounds. First, it incorporates both structural and realizational information, like the phonological transformations (Prules) of old. This is one of the shortcomings of Prules that conspiracy theory, from which OT derives, pointed out in the 70's. However, this objection is of mainly historical interest, so I do not go into it more deeply. The second objection is that the universality of NoOnset-γ makes no sense. Clearly it can only apply to languages that have a [γ]. English lacks [γ]. Thus any claim that NoOnset-γ is part of English phonology sounds vacuous: it is never violated because it cannot be violated. I return to these questions in section 5.

A more global criticism might be applied to the ranking of the constraints. These rankings emerge from the phonotactic structure of Ukrainian, which is why they are language-specific. My objection here is that they are far from arbitrary. Indeed, OT work does not claim arbitrariness here. Czaplicki spends a good deal of time arguing for the particular ranking, and the arguments are reminiscent of neo-Bloomfieldian structural justification. In short, the rankings reflect generalized syllable or phonological-word structure. Without

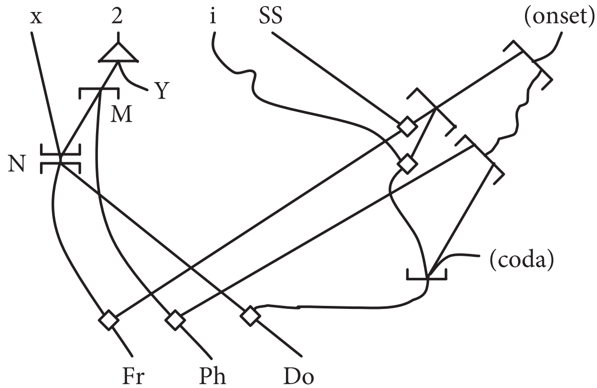

Figure 1. *The phonology of post-palatal fricatives in Ukrainian.*

a generalized description of these structural relations, the rankings cannot be seen to have a global justification. I return to this question in section 5, too.

4. A RELATIONAL NETWORK APPROACH. The complete description of the relevant portion of the phonological network of Ukrainian is given in **Figure 1**. Follow the network, beginning at the upper left (NW).

There are four lines representing inputs to the phonology from the morphology. They are labeled x, 2, i, and SS, reading from left to right. The x relates upward to the set of morphemes realized by the unvoiced post-palatal fricative. It relates downward to an upward OR at N, and I return to its further phonological relationships below.

The line labeled 2 relates upward to the set of morphemes realized by the voiced post-palatal fricative.[13] It is related downward via a triangle AND to phonemic voice (Y) and to a downward OR at M. Phonemic voice is a cluster prosody. As such it is related to a somewhat higher phonotactic (structural) level than is relevant to the rest of this description, so I say no more about it. The line down to the downward OR, however, is central to the question at issue. Its right-hand branch connects to the diamond labeled Ph (Pharyngeal). The left-hand branch neutralizes with the line from x via the upward OR at N, to which I now return. Whether N is reached from x or from 2 makes no difference. From this point on there is no distinction between their relationships. The distinctions between voiced and unvoiced phonemes are found in the relationships contracted by the lines labeled Y and Ph. Those lines reach their own points in the phonotactics separately. Conversely the downward OR at N is related to diamonds labeled Fr (frontal) and Do (dorsal).[14]

I return to the lines labeled i and SS below. Note that a wavy line indicates relationships not relevant to the current study.

Turn now to the phonotactic portion at the upper right. The phonotactics, among other things, syllabifies the input from the morphology. There is no initial syllabification supplied in the lexicon, as in some types of C-phonology. Nor is there any kind of universal preliminary syllabification rule applied, as in CV phonology. Instead, the phonotactics takes a partly linearized chain of inputs and groups them into syllable-sized units. There is

no question of licensing segments that remain unsyllabified after an initial syllabification rule (because there is no such rule) and there is thus no re-syllabification. These are all artifacts of various C-phonological theories.

Instead, RN (stratificational) phonology provides the syllabification directly. There are several possibilities at the beginning of the syllable. Some of the possibilities are shown at the line labeled **onset**. Some of the choices are marked (the left-hand line from this ordered OR, where markedness ordering is shown in the separation of the lines. The two most highly-marked choices are related to the left-hand line from the ordered OR at **onset**. One of them will be chosen if either SS or 'i' lines are active. If SS is active, the left-hand line down from N succeeds and Fr (frontal articulation) is provided (see **Table 4**). If 'i' is active the right-hand line down from N succeeds and Do (dorsal articulatiion) is provided along with softness (not shown). If neither SS nor i lines are active, the right-hand line down from the ordered OR at **onset** is taken. (Again, the wavy line indicates that some structure is omitted.) Now the marked choice is the one related to the right-hand line down from the OR at M. If this line is active, Ph (pharyngeal articulation) is provided. Otherwise, or if the phones are realized in coda position, the right-hand line down from N succeeds and Do (dorsal articulation) is provided.

This constitutes the logical network underlying a RN description of post-velar fricatives in Ukrainian. Morphemes are encoded directly, contrast is maintained, and the correct phonetic output is provided. Note that no underlying specification of features is given, so none have to be justified or rewritten. This holds for the allophonic variants as well as for morphophonemic alternation like substitutive softening. The place feature is provided only when the position of the phoneme in the syllable is known. Thus the correct feature is provided on the first try.

There are no pitfalls in the description in **Figure 1**. It can be expanded to cover the logic underlying all the facts of Ukrainian phonology and the encoding and decoding processes by which Ukrainian is spoken and understood. It also has further advantages: the phonology described is biunique; it distinguishes between morphophonemic, archiphonemic (not shown here, cf. Sullivan 1977 on Russian), and phonemic relations; it minimizes the phoneme-feature relations; and it predicts a feature geometry tree (actually reticulum) for Ukrainian. I cover these characteristics of RN phonology in previous *LACUS Forum* articles on Russian.

5. THEORETICAL IMPLICATIONS. The criticism that Czaplicki was doing historical phonology arose partly because of his emphasis on morphophonemics, as mentioned above. But the accusation could not have arisen except by examination of his underlying or input forms and a comparison of them with the surface or output forms. The assumption that underlying forms exist at all is a postulate of C-phonology and is axiomatic for OT. But without underlying forms, as Figure 1 shows, no such problem exists. A troubling postulate and its effects are eliminated. My own criticisms (cf. section 3) also become irrelevant. That is, they are all artifacts of a description effected under C-phonological postulates.

A generation ago David Lockwood (1975) characterized quasi-etymological and natural generative phonology as 'two varieties of the same mistake'. That mistake was in accepting

as an axiom the C-phonology postulate that caused Czaplicki's problem or, more generally, the assumption that a linguistic system is composed of items or things. Lockwood showed then, as I show now, that all those things and the full logic of the entire situation are fully representable by relationships alone. Actual things exist only in the real world, so his conclusions remain valid today. This points out yet again the stability and cogency of RN descriptions. What C-linguistic (not just C-phonological) description from a generation ago is still accepted as valid?

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1 What is phonemic here are the features Dorsal (Do), Oral Closure (Cl), and Voice (Y). For */k/, Y is not present phonemically.

2 In fact, these problems are only really troubling to a limited number of theories. However limited in number they are, they yet dominate the journals.

3 'Generative' phonology has never been generative, because it has never had a generative base, as Sampson 1970 points out. But it has always had rewrite rules (transformations) of one sort or another. I use the term C-phonology (C-phonologist, C-phonological) to refer to that family of theories which share a number of postulates that emerge from the work of Morris Halle and Noam Chomsky, e.g. a universal phonetic alphabet, binary features, etc.

4 For the sake of comparison I am using typical examples, most of which are also found in Czaplicki 2001 or Czaplicki in press.

5 He would not have used syllable structure, of course.

6 Axiomatic because never questioned. OT's own postulates are debated, and no OT phonologist accepts all of them.

7 But see Sullivan 1998, where I demonstrate that a generalized relational network (RN) description of a phonological system provides a principled source for feature trees while explaining the source of the problems C-phonologists using it have uncovered.

8 See Sullivan 2001, where I demonstrate that the effects of OT without the C-phonological axioms are all derivable from RN theory, making OT a theorem of (more general) RN theory.

9 I admit to being unclear about exactly what makes a violation fatal, even after generous tuition in the topic by Caroline Wiltshire of the University of Florida. On the basis of a study of a fair number of OT tableaux, I conclude that either I lack the necessary understanding or not all OT phonologists are consistent in calling a violation fatal when it is.

10 According to the Halle-Sagey Feature Geometry tree. The usual description of Ukrainian phonology states that [H] is pharyngeal, not laryngeal. I don't know what to do with this discrepancy in Czaplicki's descriptions, but it doesn't really matter. It does not affect the RN description I provide.

11 This claim shows that even OT is a basically segmental phonology (cf. Sullivan 2005).

12 To be precise, this is due to another C-phonological postulate that OT accepts axiomatically. The RN description also eliminates this problem.

[13] In a RN approach it is unnecessary, even wrong, to assign a place feature at this 'underlying' level. The features I use are, after all, actually the names of organs in the real world. A pure RN approach ends in relationships to these organs, but does not include the organs inside the description. Labels are just for mnemonic convenience. In the end, it doesn't matter what I call this line relating a class of morphemes to the phonology, so I call it '2', i.e. the second input line from the left in **Figure 1**.

[14] Note that the features I use here relate to the articulator, not to the place of articulation, which is almost never phonemic in itself.

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AUSTIN AND SAME-SEX MARRIAGE

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J. L. Austin claimed, in *How to Do Things with Words*, (1975) that there are types of sentences of philosophical interest other than the statement. His lectures argued that the **performative utterance** is such a sentence type. While not explicitly defined in his book, He treated the performative as language which performs other-than-linguistic acts. Such acts might be finding a defendant guilty or not guilty at the end of a trial, placing a bet, or getting married. Austin (ibid:7) did not explain what he meant by performing an act but assumed, apparently, the ordinary meaning of the phrase. He also assumed that it is exclusively or primarily the words that perform the act, i.e. that the acts cannot be performed without the words. He mentioned that the words must be uttered in the **proper circumstances** (ibid:16, 34) but spent very little time discussing what he meant by circumstances or what effects the circumstances have. When Austin mentioned circumstances, he often referred to the physical or social surroundings of a communicative act (**context**) to mean something like the social milieu of the utterance. Traditional linguistic theories do not have the apparatus to elucidate the role of Austin's proper circumstances or context in human communication. Some linguists use the term context to refer to the grammatical or spatial relations between words or some other parts of a grammatical theory. Austin did not use this meaning of context and, in fact, never defined context or circumstances in his lectures.[1] Context is not be used in such a way in this paper. When the term context is used here, it is used informally.

We wish to test whether Austin's claim that the words of a performative utterance are sufficient, by themselves, to perform an act. Austin (ibid:6) cited the utterance ('I do') of a bride and a groom in response to the traditional question 'Do you take X to be your lawfully wedded husband/wife?' as a performative utterance. While he was not specific, he would probably have said that these responses perform the act of marrying two people. In this paper, these responses are called Austin's **wedding performative**. It is not clear when the wedding act takes place. It may seem as though it takes place when the religious or civil celebrant pronounces the couple married, but this assumes that marriage is something that is being done to or for the couple. In Roman Catholicism, for example, the couple is said to marry themselves. The priest is the church's witness to that act and blesses it. The couple's decision to marry occurs before the ceremony. The ceremony itself is a social or public acknowledgment of that decision, and it takes place after the couple has a period of time to reconsider their decision, if necessary.

To test Austin's claim, we hypothesize that when any two people (the **couple**) appear before a person societally empowered to perform marriages (the **celebrant**), with witnesses and other societally mandated accompaniments (e.g. a marriage license) and utter Austin's

wedding performative, that they are married, i.e. the wedding act has been performed. If this hypothesis proves true, we say that the utterance of Austin's wedding performative is sufficient to perform the act of wedding. If it proves false, we say that the utterance of Austin's wedding performative is, by itself, insufficient to perform the act of wedding.

We use only one variable whose value may differ from wedding ceremony to wedding ceremony: the gender of each member of the couple that wishes to be married. We use the term **traditional marriage** for a marriage in which the couple is composed of two persons, one male and one female. In a **same-sex** or **gay marriage** (the terms will be used interchangeably), the couple is also composed of two persons, but both persons have the same gender, i.e. either two males or two females. We only admit marriage ceremonies that have no defects, i.e. we will assume that the parties are of appropriate age, the celebrant is authorized to perform marriages, the marriage certificate was properly issued, etc. This study will not argue either for or against the institution of gay marriage. The purpose of this study is to determine the limits of the notion of performative utterances (and thereby speech acts) by using gay marriage as a test case.

1. A MODEL OF AUSTIN'S WEDDING PERFORMATIVE. Hard Science Linguistics (HSL) (Yngve 1996) uses **surroundings** rather than **context** (not a technical term in HSL):

> We not only have the group of people involved but their linguistically relevant **surroundings**, that is, all the other real-world objects including the energy flows that are involved in the communicative behavior. (ibid:86.)

Surroundings refers to physical surroundings (ibid:fn 43). HSL has another useful concept: **assemblage**. An assemblage is a group of people together with their linguistically relevant surroundings involved in a particular communicative behavior (ibid:86). **Group** is not a technical term for HSL and should be understood with its ordinary meaning. The HSL apparatus is sufficient to explain the interaction of people and their physical surroundings. HSL workers have already begun exploring some of these interactions, (cf. Sypniewski 2004a and chapters by others in Yngve & Wąsik 2004).

In order to see more clearly what happens communicatively during a wedding ceremony, we create a linkage (Yngve 1996:126) called [wedding] to model the wedding ceremony of two people and provide a partial expansion in the Appendix. Formal notations, referred to as {n}, appear in the Appendix as number n. We only need to look at the role parts, prop parts, properties, and procedures which are relevant to Austin's wedding performative; much will be left out that would be included in a full model of a wedding ceremony. To model three persons, we create the role parts [person1], [person2], and [wedding official], see {1}. [person2] and [person1] each have the properties <married> initially set negative [person2]<married/no> and [person1]<married/no>. There are linkage tasks called <ceremony> and <exchange vows> and a linkage property <ceremony done> initially set to <ceremony done/no>. [wedding official] has the tasks <ask person1>, <ask person2>, and <pronounce>. [person1] has the task <affirm person2> and [person2] has the task <affirm

person1>. [wedding official]'s task <pronounce> sets the <married> properties of [person2] and [person1] from negative to positive.

The linkage models that portion of a wedding ceremony in which the wedding official asks the bride and groom whether they take each other as husband and wife, <exchange vows>. Upon affirmative responses from both <affirm person2> and <affirm person1>, the wedding official declares them to be married, <pronounce>. The linkage task <ceremony> consists of the following in this order: [wedding official]<exchange vows> → [wedding official]<pronounce>, where '→' is read 'and then execute'; {3}. <pronounce> sets <ceremony done/no> to <ceremony done/yes> and [person1]<married/no> and [person2]<married/no> to [person1]<married/yes> and [person2]<married/yes>. We can say that Austin's wedding performative is a combination of tasks and a setting procedure which changes the value of properties [person1]<married> and [person2]<married> from their initial state of negative to positive.

2. THE PROBLEM WITH AUSTIN'S WEDDING PERFORMATIVE. We might think that the description above is satisfactory to model a traditional wedding. However, the moment we begin modeling any aspect of gay marriage, we realize that the model given above is inadequate for our needs. Recall the instance of gay marriages in San Francisco where the mayor authorized the registrar to issue marriage licenses to gay and lesbian couples who then went through wedding ceremonies. After a challenge, a court said that over 3500 gay couples who went through wedding ceremonies in San Francisco were not legally married.

If we look at the proposed model of Austin's wedding performative, we see that we could not use the same linkage to model gay marriage. Austin says that after the ceremony or, perhaps even during the ceremony (after the 'I do's) the couple is married, i.e. the value of <married> changes from negative to positive in the model. Many jurisdictions disagree with Austin when it comes to same-sex marriages. There is more of communicative importance going on in a wedding ceremony than Austin appreciated. A wedding is a social act, not simply an act in which the bride and groom participate. If the gay marriage controversy has shown us anything, it is that society at large claims a stake in the wedding. This stake must be reflected in our model.

3. REWORKING THE TRADITIONAL MARRIAGE MODEL. A couple does not enter into a marriage by simply walking up to a wedding official and performing a ceremony. Prior to a wedding, the couple must get a marriage license. The issuance of a license is society's approval of a marriage. The refusal to issue a license is society's way of disapproving a marriage.[2] Just because two people are legally eligible to marry, they are not automatically eligible to marry each other. For example, consanguinity prevents a widowed mother and her adult son from marrying each other even though each might be otherwise eligible to marry (someone). Every jurisdiction that issues marriage licenses has certain standards (age, degree of consanguinity, current marital status,[3] etc.) that must be met before a license is issued. In an HSL model, [person2] and [person1] must have certain properties with certain values. Among other properties, each must have a property reflecting their gender. One must have the property <male> and the other <female> (say, [person1]<male> and

[person2]<female>) in a model of a traditional marriage. Until the gay marriage controversy, these properties were assumed to be present and rarely acknowledged consciously. This is why Austin did not consider them.

We create a linkage with four role parts: the three previously mentioned and one called [registrar] and a prop part [marriage license] {2}. The [registrar] has a task we call <review qualifications> and another called <issue marriage license>. In order for [registrar] to begin this task, [person2] and [person1] must have certain properties with certain values. [person1]<marriageable age> and [person2]<marriageable age> model the jurisdictionally required age for marriage, if the values are positive. Otherwise, a marriage would not be allowed to occur because the bride and/or groom are underage; in our model, the linkage tasks could not proceed unless this property, and other properties, had the appropriate value. In traditional marriages, [person2]'s gender must be female and [person1]'s gender must be male: [person2]<female>, [person1]<male>. If the bride and groom satisfy the jurisdictional requirements, i.e., if [person2] and [person1] have certain property values that meet the requirements modeled by a setting procedure, the registrar will issue a marriage license, modeled by [registrar] completing <issue marriage license>. Initially, [person2] and [person1] have properties called <eligible to marry> both of which are set negative. In <review qualifications>, if [person2] and [person1]'s properties meet certain qualifications, <eligible to marry> is set positive. Only then can <issue marriage license> be performed. No marriage license is issued if <eligible to marry> is negative, i.e. <issue marriage license> cannot be performed when <eligible to marry/no> {7}.

In the <issue marriage license> task, a setting procedure changes the [marriage license] prop's <issued> property from <issued/no> to <issued/yes>. It is only when this property change takes place that <ceremony> can be performed {4}. If <issued/no>, <ceremony> cannot be performed. If [person2] and [person1]'s pertinent properties do not satisfy <review qualifications>,[4] our model shows that no marriage ceremony can take place, which is what we observe in the real world.

4. MODELING A GAY WEDDING. In traditional marriage, <review qualifications> includes [person1]<male> and [person2]<female> {5}. In a same-sex marriage, we have either set of properties: [person1]<male> and [person2]<male> or [person1]<female> and [person2]<female>. Neither set satisfies <review qualifications>, if it contains the traditional marriage gender standards. We see that [person1]<eligible to marry> and [person2]<eligible to marry> can never be set from negative to positive. When we model a same-sex marriage, we must use a different model for <review qualifications> {6}. We eliminate any reference to a <gender> property, allowing [person1]<eligible to marry> and [person2]<eligible to marry> to be set positive regardless of the genders of the persons being married. We do not need anything else to model the difference between traditional marriage and same-sex marriage but a setting procedure in <review qualifications>. Even a court ruling reversing or affirming the legality of gay marriage may be modeled as tasks, procedures, etc. that determine the setting procedure to be used.[5] What we see is that a model of the California court ruling rejecting San Francisco's issuance of marriage licenses to gay couples would effect the properties of the role parts [person1] and [person2],

specifically [person1]<eligible to marry> and [person2]<eligible to marry>. They would be set negative after a task that might be called <ruling> in a model of the court ruling. Without further details, I note only that the [wedding] could be a subordinate linkage to the linkage modeling the court's decision. Neither <issue license> nor <ceremony> can execute if either [person1]<eligible to marry/no> and [person2]<eligible to marry/no> are reset to negative.

4. DISCUSSION. Our examination of Austin's wedding performative using HSL techniques leads us to say that his hypothesis, that words alone are sufficient to perform the wedding act, is false. Two couples, one traditional and one same-sex, could utter the same words in proper circumstances and achieve different results. The gender variable alone accounts for this in some legal jurisdictions. We must also reject the hypothesis because it may be true or false due to accidents of time or geography. Austin isolated the performative from society and did not sufficiently account for the rather simple observation that the wedding performative is the end-product of a chain of events rather than the sole trigger for the wedding act. There is something unreal about a performative utterance when context is not considered. Two of the differences between the HSL reconstitution of the wedding performative and Austin's claims are that the HSL model is much broader in scope and includes the relevant parts of the social milieu of the wedding. Indeed, HSL challenges the notion that objects of philosophical or linguistic interest can be properly studied in isolation from their social milieu, and says that our studies should and must consider context in a way and to a greater extent than Austin did. Furthermore, Austin did not consider the possibility that a speech act may be reversed. For him, once a speech act is performed, it is completed. Folk wisdom says that once words are spoken, they cannot be taken back. Like much folk wisdom, a scientific review shows that this is not always the case. The effects of communicative behavior on people may be reversed by appropriate actions, even the actions of third parties. In HSL terms, this means that property values can be reset. When property values are reset, tasks need to be re-executed with those new property values.

Austin created a closed world; Austin's model is, therefore, brittle. HSL insists on an open world. A speech act has no semantic meaning for Austin. Austin's study was certainly an advance over the simplistic view of the statement as the sole interest for philosophers by arguing that words can not only state but do. While this may appear to create dynamism where previously there was only stasis, the dynamism of Austin's claims is more apparent than real. The less context is considered, the more static an utterance becomes. Without considering context, a performative utterance becomes just another type of sentence or text alongside of the statement, a matter of, shall we say, philosophical interest only.

Austin never said what he meant by words doing something. Doing what? Communicating? Affecting something? HSL shows that communicative behavior, a term broader than speech, alters other types of behavior. In our models, property values are changed, tasks are performed, and procedures are executed. HSL is truly, not apparently, as dynamic as life because it concentrates on people. If the researcher claims that a property value is changed, he or she must show it clearly in the model. HSL models have the attribute of clarity; HSL models need no interpretation. All is there to see, on the surface.

If we look at what happened in California when a court reviewed the San Francisco situation, we see that at the time of the ruling the court rendered certain previously uttered phrases meaningless. Phrases like 'I now pronounce you spouses forever', often used in gay weddings to replace 'I now pronounce you man and wife', had no meaning after the court ruling or, at best, a lingering social meaning rather than a legal one. There was a temporal limit to the semantics of the ceremonial language used in these weddings. The court ruled that there were *no wedding acts performed despite the language used*.

This judicial behavior is not unusual or limited to the gay marriage situation. While a divorce is the most common way of terminating a marriage, most jurisdictions also permit annulments. Assuming that the plaintiff proves certain things, a court will rule not just that there is no marriage now, i.e. at the time of the ruling, but that there was no marriage then, i.e. at the time of the wedding ceremony.[6] The ability to reverse a decision has important linguistic implications, especially for semantics. Meaning, however defined, should not be static, like Austin's performative utterances, but must be dynamic, like HSL's reconstitution of them. Reversing a decision may also reverse or nullify meaning. The utterance 'I now pronounce you spouses forever' uttered prior to the California court ruling is not wrong (whatever that might mean) once the court ruling was handed down. The wedding official was not incorrect. The court ruling retroactively made the utterance meaningless or, in HSL models, without effect. Meaning has a duration which may be long or short depending on circumstances. HSL can model time delays, (Yngve 1996:262 et seq.). The effects of time play an increasingly important role in our research.

The reader may wonder why HSL terms such as *surroundings* and *assemblage* are limited to physical objects. Surely, the qualifications for obtaining a marriage license are social in nature and are not real things. The answer is simple if not obvious: there is no need to distinguish between *real* and *social* objects in our models. We can model social matters and concerns by creating setting procedures and the like which refer to the properties of participants, role part, prop parts, or linkages. As properties, they are testable. Real world objects have properties which are testable for existence and attributive qualities. Our target is not to create theory; our target is to create testable models of the real world. Austin's model as stated in his terms is not testable. Austin (1975:13) tried to create a hierarchy of errors or, as he called them, 'infelicities' for performative utterances and used terms such as 'happy' and 'felicitous' for properly formed and uttered performatives. These are not enough to make his theory testable. His terms are too vague to provide standards for us to gauge the correctness of models. Testability is important to HSL. Testability means that we do not create our models from whole cloth. We must show that our models accurately reflect our observations of people in the real world. If, after testing, our model does not predict what we see or measure, our models fail. New ones must be built or old ones corrected. HSL does not permit unworkable models to linger about the margins.

5. CONCLUSION. Our brief examination of Austin's wedding performative in light of the current gay marriage controversy shows us that words do not perform acts in the way that Austin suggests. Words do not perform acts at all. People perform acts. The present paper does not discuss Austin's felicity conditions because they are irrelevant. People cannot be

seen as part of a condition to make words do something. This is backwards. To account for a wedding properly, we must construct a model of the societal as well as the individual aspects of the ceremony. The actual proper circumstances of a wedding ceremony are much broader than the circumstances Austin considered. We can be much more precise in our models than he could and we should do so.

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[1] While this grammatical sense of context is beyond the scope of this paper, HSL can have something to say about it. See Burazer 2004.

[2] There are many reasons to disallow a marriage: age, physical condition (a person with a sexually transmitted disease can't marry until it is cured), currently valid marriage, etc. The exact impediments, as they are called, vary from jurisdiction to jurisdiction.

[3] Not all marriages involve only one male and one female. In traditional Islam, a man may marry up to four women at a time. Until a nineteenth-century Supreme Court ruling, Mormons in America could be polygamous.

[4] In a more complete model of [wedding], the qualifications would be modeled as linkage properties. <review qualifications> would contain a matching procedure to compare the relevant linkage properties with the properties of [person1] and [person2]. The reader should consider the description of <review qualifications> presented in this paper as a sort of shorthand.

[5] Of course, here we are talking about the model of the events in the real world, not about the real world events themselves. The setting procedure is a model of the qualifications necessary for two people to get a marriage license. The court rules on the qualifications, not on the setting procedure, which is an object of theory.

[6] The legal term is void *ab initio* 'void from the beginning'.

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APPENDIX

1. [wedding]=[person2] + [person1] + [wedding official]
2. [wedding]=[person2] + [person1] + [wedding official] + [registrar] + [marriage license]

3. <ceremony>=[person1]<married/no> x [person2]<married/no> x <exchange vows> x [wedding official]<pronounce> :: [person1]<married/yes> x [person2]<married/yes>
   a. [wedding]<exchange vows> = [wedding official]<ask person1> -> [person1]<affirm person2> -> [wedding official]<ask person2> -> [person2]<affirm person1>
4. [wedding]<ceremony> = [person1]<married/no> x [person2]<married/no> x [marriage license]<issued> x <exchange vows> x [wedding official]<pronounce> :: [person1]<married/yes> x [person2]<married/yes>
5. [registrar]<review qualifications> = [person1]<male> x [person1]<marriageable age/yes> x … :: [person1]<eligible to marry/yes>
   [person2]<female> x [person2]<marriageable age/yes> x … :: [person2]<eligible to marry/yes>
6. [registrar]<review qualifications> = [person1]<marriageable age/yes> x … :: [person1]<eligible to marry/yes>
   [person2]<marriageable age/yes> x … :: [person2]<eligible to marry/yes>
7. [registrar]<issue marriage license> = [person1]<eligible to marry/yes> x [person2]<eligible to marry/yes> :: [marriage license]<issued/yes>

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FOCUS OR SCOPE OF PITCH ACCENT: SPEAKER VERSUS HEARERS

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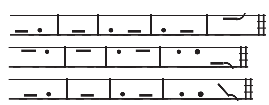
HALLIDAY'S (1967:208) *John painted the* ***shed*** *yesterday*, Chomsky's (1970[1972]:93) *was he / he was warned to look out for an ex-convict with a red* SHIRT and Selkirk's (1995:554) *Mary bought a book about BATS* are examples of ambiguity between narrow and broad(er) scope or domain of focus, with only the highlighted word, or (up to) the whole sentence being **new information**.[1] If that 'nuclear pitch-accent' is on the subject, the whole sentence cannot be new, only the subject, the rest being given or **presupposed**. According to Selkirk's (representative) survey, 'the *central problem* in the characterization of the prosody-focus relation' remains that of 'focus projection,' i.e. of scope of accent. In her example it could range from *BATS* to the whole sentence, thus: $_{FOC}$[Mary [[bought]$_F$ [a [book]$_F$ [[about]$_F$ [[BATS]$_F$]$_F$]$_F$]$_F$]$_F$]$_{FOC}$ depending on whether it is an appropriate answer to the (potential) question *What did Mary buy a book about?, What kind of book did Mary buy?, What did Mary buy?, What did Mary do?* or *What's been happening?* Indeed, Halliday's (original?) idea of **focus structure** seems to have mushroomed over the past 40 years into a vast, mainly generative, industry, witness Breul (2004:46) and its title: *Focus structure in generative grammar: An integrated syntactic, semantic and intonational approach.*

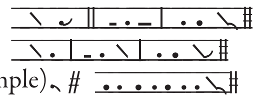
For an observer wishing to familiarize himself with this literature, there are at least three serious obstacles: (i) the absence of prosodic notation, (ii) the discourse criteria employed and (iii) the role played by the hearer(s) and/or speaker in all this.

(i) Only Halliday regularly employs a prosodic notation, based on previous analysis of speakers' intonational and rhythmic options. Generative authors, however, the vast majority, merely offer spelling versions with one or two capitalizations. Characteristically, Selkirk (1995:553) only says 'Capitals indicate the presence of a H* pitch accent on a syllable' (except, we assume, for the capital in *Mary*). This suggests the spoken form SSSSL in (1) when in fact something like the second SSSL or even the PPL form may actually be intended, where S = (non-tonic) STRONG-stress syllable/word/byte; L = LATE nuclear tonic ditto; P= PRE-nuclear tonic ditto. The symbols |, // and # will mark off byte=rhythmgroup, piece=tonegroup and locution=breathgroup respectively. Of course there are hundreds of spoken sentences corresponding to the written sentence *Mary bought a book about BATS*, all with different meanings. Similarly, there are many many spoken sentences corresponding to each of Selkirk's written (potential) questions, also all with different meanings, and therefore asking for different answers.

(1) S|S|S|S|L# ˍmary| ˍbought| a ˍbook| aˍbout| ˉBATS #
S|S|S|L# ˉmary| ˉbought| a ˉbook| a·bout ˍBATS #
S|S|S|L# ˍmary| ˍbought| a ˍbook| a.bout ˋBATS #



(1) L//S|L# ˋMAry◡// ▫bought a -book| a.bout ˋBATSˎ #
P|P|L# ˋMAry| ▫bought a ˋBOOK| a.bout ˋBATS◡ #
L# (the) .mary .bought a .book about ˋBATS| (e-xample)ˎ #



It is only since about 1990 that generative linguists have developed the **Tones and Break Indices or ToBI** notation, based on Pierrehumbert (1987), but this still seems but rarely used in their work on focus. Moreover, ToBI is an **off-line** notation unlike Halliday's and our own, and is far less detailed and precise. This remarkable lack of prosodic information makes it rather difficult to reconstruct or judge the reading of any example given. Explicitness, so dear to the hearts of generative linguists, seems curiously set aside when they present linguistic data and observations. In (1) I introduce an **in-line** prosodic notation, to be further explored below.

(ii). The criteria generally used are discourse criteria: exchanges either of the form (potential) question—appropriate or natural answer, or example—appropriate or natural (potential) response. Since most such exchanges (such as Selkirk's) strike me as extremely unnatural and inappropriate, no matter how I read them out loud, I searched for a definition or explanation of 'natural = appropriate' (my italics):

(2) Chomsky (1970[1972]:94) 'For *naturalness*, question and answer (or denial and corroboration) *must* not only *share presuppositions*, but *also* must use as focus items that are *somehow* related – exactly how is not clear, but the relation *surely* involves considerations that extend beyond grammar.'

(3) Jackendoff (1972:230). '*Intuitively*, it *makes sense* to speak of a discourse as *"natural"* if successive sentences *share presuppositions, that is*, if the two speakers implicitly agree on what information they have in common.'

This is not terribly helpful, either. Having just been told that sentences can be 'all new = all focus' how can they possibly *share presuppositions* they haven't got? Also, Jackendoff's *that is* seems easily falsified, for instance by # your ˋCOLleagues| -plagia▫rized| a -vide.o| on ˏBATSˇ# followed by # .did my ˋCOLleagues| -plagia▫rize| a -vide.o| on ˏBATSˇ# with both foci and presuppositions maximally in common. Such 'two speakers' clearly *dis*agree on what information they have in common. The other italicized words in (2) and (3) are no more than wishful thinking. Again, what happened here to the explicitness so crucial to generative linguistics? It is impossible to work with these concepts.

(iii). Halliday's work on focus was preceded by a detailed study of the phonological hierarchy, rhythmic and intonational structure of tape-recorded speech. Generative linguists pursued the study of focus structure without any such prior theories or descriptions. It was only much later that some generative phonologists began to re-invent the wheel: the syllable, phonological hierarchies, metrical structure and intonation. This explains, I think, why generative linguists only concerned themselves with hearers' so-called intuitions (see Jackendoff above) about new and given information without ever considering the far richer immediately observable patterns of speech. Disappointingly, Halliday's focus theory, in spite of his previous work, also depends on interpretations by the hearer. It is

difficult to tell who influenced whom on this point, as the authors concerned do not mention each other much. Chomsky's (1970) ideas on accent and focus are almost the same as those in Halliday (1967). But Halliday's (1967:208) distinction between unmarked or new focus with the tonic nucleus on the last lexical item and marked or contrastive focus with an earlier nucleus expresses the same sentiment as Chomsky and Halle's (1968) Nuclear Stress Rule and its distinction between normal and contrastive stress (= tonic). This is the more amazing as the NSR was soon after shown to be untenable by Bolinger (1972). One can only surmise that at the time discourse analysis, and therefore hearer's interpretations, were just in the air.

Not only does focus theory restrict itself to meaning for the hearer, it never seems to consider more than one hearer at a time. This, too, strikes us as unrealistic. When a Eurovision Song Contest presenter recently announced without preamble # i'm a▬fraid| we're .having a ˺TECHnical| ▬hitch⸜# , some of her '600 million viewers in 35 countries' perhaps took the whole locution as new, others only *technical* or perhaps *technical hitch,* some perhaps couldn't connect the not-new information *hitch* to their own state of mind, not to mention those who were not too sure of its meaning in the first place. With the other 599 million hearers it probably just went in one ear and out the other.

1. NOTATION AND ANALYSIS OF RHYTHM AND INTONATION. Doing prosodics without a prosodic notation is not a good idea. The in-line notation employed in this article is largely explained in (1) by showing that it corresponds directly to a detailed dots-and-dashes notation. This seems preferable to Halliday's abstract in-line prosodic notation, apart from the fact that the underlying analysis of British English rhythm and pitch is also somewhat different. To justify our notations and the semantic conclusions drawn from them, the analysis is summarized in **Table 1** (overleaf). More details are in Van Buuren (2004, 2005). The following remarks may also be helpful.

As can be seen, we practice a FORM↔MEANING approach. Bolinger (1907–'98), more than anyone else, often demonstrated that intonation has little to do with syntax but everything with direct highlighting of words or concepts by means of pitch movements having meanings of their own, 'part of a gestural complex whose primitive and still surviving function is the signaling of emotion' (Bolinger 1985:195). Since much of gesturing, pitch, rhythm and timing seems controlled by our old mammalian brain, this suggests that, in evolutionary terms, the development of prosody started before that of the cerebral cortex, and therefore well before that of vocabulary and syntax. Another indication of its **pre**-syntactic status is the striking similarity (allowing for superficial differences) of intonation (and rhythm, but not timing) in, say, English, Romanian, and even American, Asian and African languages (Bolinger 1985:197).

Writers on intonation and even lay people often notice rhythmic/intonational units with a direct form↔meaning connection, as well as for the pitch accent to which some linguists restrict themselves. The meaning of a tonegroup is often said to be an information-unit. Halliday (1994:302) talks about the 'basic meanings' of his 5 tones and of falling and rising pitches. Laymen often use 'question intonation' for rising and 'statement intonation' for falling tunes, and so on. However, such form↔meaning observations are usually ad

symbol	sign	form	meaning
(space)	word	close juncture phonetic entity	*concept*/referent = neurocognitive conceptual node activation
|	byte	rhythm-group (hierarchy), one S/T, ralentando 1	*thought* = neural-cum-physical grouping/pointing gesture
//	piece	melodic group (F/f or R/r tune), ralentando 2	*idea*/sense-group: constellation of thoughts = 2–5 sec. nc loop
#	locution	breath-group, ralentando 3	*sententia*: constellation of ideas = nc loop of loops
ˎ ˋ	F/f piece	having major/minor falling tune	*and nothing else in mind* = nc blocking of other loops
ˏ ˊ	R/r piece	having major/minor rising tune	*NOT and nothing else* = without nc blockings
__ —	C piece	chanted level-ending F or R piece (calling pattern)	*proclaimed confirmation*: routine reactivation of nc loop
	L byte	having Late Tonic on L word/syllable	*creates/introduces* thought, hence new situation/context
	E byte	having Early T on E word/ syllable	*discovers/reveals*thought within following S-thought(s)/context
	P byte	having Pre-tonic on P word/ syllable	*selects* thought to operate within following newer choice(s)
- ‾	S byte	having Strong stress on S word/syllable	*specifies/names/identifies* existing thought (no contrasting)
▫ ▫	M word	having Medium stress, but no S or T	*sub-specifies* sub-thought/byte within byte
	u word	unstressed/suppressed: z(ero) or automatic w(eak) stress only	*mentions/refers* to given / automatic reflex concept
. ˙	w word	u-word chosen for w-stress	*favoured* u-word: sub-sub specification of byte in byte in byte
◥	+T word	having +tone: upjump+fall on Tonic syllable	*committed*, 'un-obvious', neutral choice
◣	–T word	having –tone: downward jump on T syllable	*obvious*, expectable, accepted, choice
◤	=T word	having =tone: upward jump only, on T syllable	*uncommitted*, equivalent, random choice
▲	xT word	having xtone: downjump on T syllable, then rising-falling	*unique* choice

Range: the bigger/smaller the pitch-jump, the more/less committed/obvious/random/unique the choice.

Table 1. *18 Saussurean signs accounting for rhythmic and intonational choices.*

hoc. Ours are systematic, on the simple principle that if there is any truth in all this, it is worth working out consistently.

Both my analysis and notation allow for rhythmgroups or **bytes**, two degrees of stressed and two degrees of unstressed. Stress is an aspect of rhythm, its beat. It is not, as some think, an object one can pick up and carry from one syllable or word to another. Nor should it be identified with pitch-accent: one can have rhythm without melody. Its analysis rests on our definition of rhythm (Van Buuren 2005:115) as the 'RAPping' of events within one's (2–5 second) psychological present into (hierarchies of) TROchees, (+)DACtyli, (+)amPHIbrachs(+), iAMBS, anaPAESTS(+) and/or MONES. RAPping here means grouping in agreement with a Rhythmic Alternation Principle and + stands for syllable. The reason why the description of rhythm in language is generally minimal is because the phenomenon is ill-understood.

Another distinction lacking in most descriptions is that of T(onics) into L(ate nuclear), E(arly nuclear) and P(re-nuclear) on the basis of sequence. T means 'not not' (Keijsper 1985:182), i.e. **contrast, new.** When L, that creates or introduces a new context or situation. When E, i.e. followed by one or more not-new thoughts, it uncovers or reveals a new thought within that context. When P, i.e. followed by a newer thought, it selects among the few candidates to which the open range of alternatives is reduced by the newer thought.

Since meaning is ultimately a matter of neurocognitive (nc) processing (Lamb, 1999) rather than of truth-conditional or speech-act considerations, I also give some indication, still tentative, of the most likely nc equivalents of the meanings recognized, hopefully also open to falsification. Cf. Van Buuren (2004).

2. SOME REMARKS ON HALLIDAY'S PROSODICS. As a postgraduate Edinburgh Phonetics Diploma student in the early sixties I was extremely fortunate in having David Abercrombie, Trevor Hill, Betsy Uldall, Ian Catford, John Sinclair and also Michael Halliday among my teachers. Of course we were all Firthians at the time, but Halliday for one was also known to be in touch with Sydney Lamb, of Stratificational Grammar fame. I still feel that this 'Edinburgh School' was unique in *integrating* practical linguistic/phonetic observation, experimentation and teaching with theory building. Rather sadly, it was short-lived. Soon, all was to be inundated by the TG tsunami or swept away to distant shores. But some of us still hang on to its theory-cum-practice philosophy.

It was during this period that Halliday studied tape-recorded conversations (by means of cleverly constructed loop-repeaters) resulting in *The Tones of English* (1963) and *Intonation in English Grammar* (1964). His was one of the first (and extremely rare!) attempts by a grammarian to get to grips with spoken, as opposed to written language. However, I think it is fair to say that Halliday, as he himself made clear more than once, was far more interested in the aim than the means. He was and is not much interested in phonetics, as may be clear from the fact that he unquestioningly took over Abercrombie's still rather sketchy theory of rhythm and, to my knowledge, never went to the trouble of seriously revising or updating his original analysis.

If Halliday's analysis is compared with that set out in **Table 1**, it will be seen that we agree, on the whole, on the phonetic data and the number of options open to a speaker

of British English. His in-line prosodic notations, although somewhat vague about pre-nuclear pitch movements, can generally be quite closely translated into our own notation. But we disagree on the phonological and semantic analysis of the data. A detailed comparison is neither possible nor necessary here. In any case, I reiterate that I regard Halliday's original analysis as most inspiring and revealing, even after more than four decades. But a few critical remarks may be in order.

As explained, I postulate a direct connection between phonological prosodic options and their meanings. For Halliday, the connection is *via* grammar, although from Halliday (1967:200ff) onwards he does talk about *the* meaning of a tonegroup being 'information unit' (while the 'foot' is said not to have a meaning of its own) and about the 'basic' meanings of tones 1–5. In retrospect, it may seem surprising, therefore, that Halliday never developed or even considered an immediate form↔meaning approach, which, if workable, would simplify matters enormously. As it is, I could never see the wood for the trees in his 1964 *Intonation in English Grammar* and still find it rather indigestible. I now think I have found the explanation. As suggested, at the time J.R. Firth was virtually our guru, and one of the dogmas of Firthian phonology was 'polysystemicness'. In that historical context Halliday's tone 1 in declaratives, for instance, could have nothing to do with tone 1 in polar or wh-interrogatives, imperatives or moodless clauses, and hence the complicated journeys from phonology to semantics through the labyrinths of grammar instead of the direct form↔meaning approach I am now advocating.

One effect was that the functions of intonational choices were investigated in a previously-developed grammar of *written* English rather than as a pre-syntactic phenomenon. Rhythmic choices, moreover, were hardly considered. A further effect was that grammatical and prosodic units/boundaries often do not coincide. Halliday's tonegroup-boundaries are often drawn in the middle of clauses, where the typical tune-final 'ralentando' with upturn or downturn in pitch would indeed be most unlikely. It is as if a speaker has to carry out two unrelated activities at the same time, one syntactic and one prosodic. This effect is compounded by Halliday's rejection of the old Armstrong and Ward (1926) F/R tune contrast, even though it was defended in Hultzén (1959), on which Halliday's information points approach is largely based. If there are no tunes, there are of course no tune-endings to be perceived or considered. Like other British intonationalists, Halliday conflated the two tunes and three or four tones, in his case into 5 tones. It is encouraging to see, by the way, that a generative intonationalist (Pierrehumbert 1987) has brought the Falling/Rising-tune distinction back to life again.

Perhaps the main historical reason, however, for this *clash* beteen syntactic and prosodic units/boundaries was Halliday's adoption of Abercrombie's theory of rhythm. I was equally impressed by Abercrombie's work at the time. But that was also nearly half a century ago. Since then, one may hope, we have become a little more sophisticated. Abercrombie postulated, as many still do, that speech was divided into feet, each starting with a possibly silent stressed syllable and followed by 0 or up to 5 or 6 syllables. This allows for MONE, TROchee, DACtylos, DACtylos+, etc., but not for iAMB, amPHIbrach or anaPAEST. Also, it allows for only two degrees of stress, S(tressed) and u(nstressed) as against our four degrees. This is because Abercrombie did not recognize what Selkirk (1986:12) calls PRA

and I call RAPping, i.e. a Rhythmic Alternation Principle saying: no more than two weaks between Strongs, and no more than one at beginning or end. What it all amounts to is that Abercrombian foot-boundaries are often drawn in the middle of words and larger constituents, as in Halliday (1994:304). Cf. also his notation in (4) with ours in (5) .

(4) 4 ^ if / you sug/**gest** it's /beautiful// 1 they / **see** it as / beautiful //
(5) ·if you sug▴gest| it's ˍbeauti.ful⌄// they ˋsee it| as ˍbeauti.ful⌄#

The basic meaning of our rhythmic unit, the byte (we avoid the loaded term *foot*) is a single neurocognitive *gesture* or thought. It is not surprising that Halliday does not see a form↔meaning correlation in feet that include *gest it's, see it as* and *you sug,* although he does recognize, in an ad hoc manner, the semantic role of rhythm in stressed versus unstressed *needs* (our S-word vs u-word) in *it needs to have love* (Halliday 1994:297, 2004:90).

One final point is that Halliday not only regards the tonegroup as a form↔meaning unit, but also treats the word as such (e.g. by leaving spaces between them in his prosodic notations). However, since the phonological word was not included in his hierarchy tonegroup>foot>syllable>phoneme, that also goes to explain why no form↔meaning unit foot was recognized between the tonegroup and the word.

3. DOMAIN OF STRESS AND TONIC FOR SPEAKERS. Halliday's (1967:208) *John painted the* ***shed*** *yesterday*, Chomsky's (1970[1972]:93) *was he / he was warned to look out for an ex-convict with a red SHIRT* and Selkirk's (1995:554) *Mary bought a book about BATS* are all said to be ambiguous between narrow and broad(er) scope or domain of focus. Getting rid of John, Mary and 'he' (whoever they may be) let us consider some parallel but less predictable or expectable examples:

(6) SSSL (.did) your ˍcolleagues| ˍpulve▫rize(d)| a ˍvide.o| a▫bout ˋBATS⌄#
(7) ESSS(S) (.did) your ˋCOLleagues| ˍpulve▫rize(d)| a ˍvide.o| about ˍbats| (aˍgain)⌄#

In both the statement and question forms of (6) the three S-bytes before the L-byte introducing/creating a new context merely Specify (i.e. identify, name) concepts/ thoughts already existing within a neurocognitively activated area of perception or awareness. It is obvious that one cannot possibly ask question (6) if *colleagues, pulverize, video*, are not in mind already, and the same must apply, mutatis mutandis, to the corresponding statement. Note that the domain of both S and L (= late T) is the byte (not the word, sentence or whatever). As indeed implied by Halliday, the (informational/semantic) status of (groups of) words will therefore change with different byting, as in # my ˍcolleagues| .need a ˍvide.o| aˍbout| ˋBATS⌄# etc., or in # ˋWOULD you| ˎSTART| ˍreading .at| your .colleagues .pulve.rized a .vide.o about ˋBATS⌄// ˍplease⌄// or ˍwould you| ˋRATHer| ˍread| .one flew .over the .cuckoo's ˋNEST⌄#. Crucially, there seems to be no neurocognitive, structuring reason whatever to assume that the speaker's Specifications of concepts/thoughts in mind will be any different, depending on whether these were just activated by a specific question about the kind of video these colleagues pulverized OR by 'what's happening?' OR by the

preceding discourse in general OR by visual perception of a pulverized video OR by the speaker's experiences with these colleagues on previous occasions. In speech production, S-bytes can never be new or included in the newness of T-bytes.

The authors quoted all seem to maintain that, unlike the L-piece (6), a statement like (7) with E-tonic on the Subject can not be (i) all new or (ii) said in isolation, as (iii) it can only answer *Who pulverized a video about bats?* Again, such views rest on a confusion of speakers with hearers. At the risk of even more confusion, we agree, of course, albeit for quite different reasons, with (i) and (ii) while disagreeing with (iii) as far as production is concerned. But concerning reception, we disagree with (i), (ii) and (iii). For instance, simple addition of the S-word *again* at the end, makes (7) quite acceptable to hearers as an out-of-the-blue, all-new statement not answering any particular question, and so are the following pieces with E-tonic on the subject, all included, for good measure, in one breath or locution:

(8) ˋSORry⌄// my ˋWIFE'S| -calling .me⌄// the ˋBAby's| -caught| a -cold↘// my ˋCAR'S| -given .up| the -ghost↘// the ˋNEIGHbors| are -making| a -pest| of them-selves⌄// ▫joan ˊCOLlins| is ¯gimbling| the ▫old ¯flight ▫path| as ˊusual✓// our ˊDOG'S| ¯kicked| the ¯bucket✓// and ˎJOHN'S| -painting| his .stupid -shed| a-gain| of -course↘// but ˋWHO the ▫hell| ▫wants to -know| ▫all these -things↘// ˋANy▫way↘#

In all these cases of E-nucleus, each of the S-bytes making up its context identifies a not-new concept/thought in an already activated area of speaker awareness or consciousness, just as it does in the L-examples . We must conclude that the concept of broad(er) scope or domain of Tonics (and Stresses) does not apply to production, and neither, therefore, does the so-called ambiguity between narrow and broad(er). The domain of T or S is always narrow, restricted to no more and no less than its byte.

4. DOMAIN OF STRESS AND TONIC FOR HEARERS. This is a harder nut to crack, as language does indeed tend to be highly ambiguous to hearers. If one says # i'll ˊSEE| my ˎGIRL ▫friend| on the -bus| ▫back ˋHOME↘#, hearers may wonder if the girlfriend, the speaker, or both will be on the bus, or even perhaps whether they keep a toy bus at home to play interesting games on, and so on. One wonders whether linguists should spend their energy studying such ambiguities and misunderstandings, as there seems no end to it. After all, speakers activate only one idea at a time with one nc process and one meaning, not as suggested by $_{\mathrm{FOC}}$[Mary [[bought]$_{\mathrm{F}}$ [a [book]$_{\mathrm{F}}$ [[about]$_{\mathrm{F}}$ [[BATS]$_{\mathrm{F}}$]$_{\mathrm{F}}$]$_{\mathrm{F}}$]$_{\mathrm{F}}$]$_{\mathrm{F}}$]$_{\mathrm{FOC}}$ with a multitude of structurings and meanings. That one product is what really matters.

We live in Holland. My wife's sister lives in California. Consider my options in (9):

(9) your ˋSIster| .is in -town/ the -country/ -holland/ -amster▫dam/ -england/ -london/ -germa.ny/ -moscow/ ▫timbuk-tu↘#

The S/Specified (not T/contrastive) options *in town* and *in the country* are normal, acceptable not-new thoughts to any hearer, because they exist permanently within everyone's

active mental ambit, one's horizon of awareness, as do common verbs like *need, buy, go, like* and times like *yesterday, tomorrow, last week*. My wife would equally accept *in Holland* as a not-new thought because that, too, is within our active ambits. For an English or American hearer to catch on, however, I would make it T/contrastive/new, if (a very big if) I could muster the energy, consideration, cultural knowledge and psychological insight to assess my hearer's shared presuppositions as focus/communication theorists assume speakers to do. Frankly, I do not always bother, and I know many people who never bother, being far too busy with themselves. For them, at least, language is less a means of communication than of self-expression.

My dear wife would even accept *in Amsterdam* as a not-new Specified thought, although we do not live there, by doing some associating within her experience and awareness. Unlike most people living in Holland, she would also readily accept Specified (i.e. not contrastive) *England* or *London,* because we have strong personal connections with these places, as does her sister, for that matter. But *in Germany* could be a real poser, possibly eliciting reactions like *we weren't talking about Germany; obviously he is thinking about it, but I wasn't,* unless of course we happened to be holidaying in Germany, someone was waving a German flag on television or she had actually just heard it mentioned by whoever. The concept *Moscow* would be still more difficult for my infinitely patient listener to activate as part of our present concern, but note that a speaker could cleverly get round that problem by prefacing this option with something quite vague, like # ˺TALking| a_bout| ˺STALi.nism ⌄//... Apparently, in that case, the hearer would associate Stalinism with Russia with the *Moscow* to follow. and not-new *Moscow* is actively integrated into our present concern.

I must admit that I find this the hardest bit to explain, and my wording is still suggestive rather than precise. What it seems to amount to is that, for hearers, just as for speakers, S-bytes are never new information (or thoughts, rather) as focus theorists maintain, nor given (as the u-words *your, is* and *in* are in the example) but always not-new 'familiar' thoughts to be (re-)activated and integrated into the current (new) piece/idea = constellation of thoughts.

Roundabout integration of not-new *in Timbuktu* into our present concern does not readily suggest itself. But there is at least one strategy one could employ here, as well as in the other cases. That is to present *sister* not with a +tone (upjump&fall) as a neutral, committed option, but with a –tone (downward jump) as an obvious, expectable option. Certainly with appropriate voice quality and facial expression, the effect/ interpretation could then be something ironical like 'Surprise, surprise, your sister is in Timbuktu, of all places', with the not-new S-word Timbuktu properly integrated.

5. CONCLUSION. This discussion tried to show that variable scope of focus or focus projection does not exist for speakers *or* for hearers. If so, the so-called central linguistic problem of focus projection, indeed perhaps the whole of focus structure would be a pseudo-problem. Given that progress in science requires the falsification of theories, I gladly invite more experienced writers on focus-theory to prove me wrong.

[1] I am most indebted to three anonymous LACUS reviewers and the editors for pointing out weaknesses in earlier drafts of this article.

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FORMALIZING THE OBSERVER IN HARD-SCIENCE LINGUISTICS

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HARD-SCIENCE LINGUISTICS makes it easy to formalize the observer and doing so brings unexpected advances in theory. It becomes easy to handle such previously puzzling or anomalous matters as understanding in context, variation, connotations, monitoring, concepts, and much more in a way that fits with the rest of hard-science linguistics to form a unified whole.

In its basic assumptions about science and in deciding what to believe about the world, hard-science linguistics follows the highly-developed hard sciences of physics, chemistry and parts of biology. It accepts only the two standard criteria and four standard assumptions of the hard sciences that have developed over four centuries in the natural sciences and have made possible the startling advances in science we have witnessed there. No one has a patent on them: they are freely available for use by anyone wishing to join the worldwide scientific community. Hard-science linguistics explicitly accepts them and none other.[1]

Hard-science linguistics studies people rather than language and is defined as the scientific study of how people communicate rather than as the scientific study of language. Thus hard-science linguistics (HSL) is sometimes called human linguistics (HL) in contrast with the traditional linguistics of language (LL).[2]

1. LINGUISTIC MODELING IN A HARD SCIENCE. Hard-science linguistics studies real people and other parts of the real physical world. People are modeled in terms of dynamic systems. How they communicate is modeled in terms of postulated communicative properties of these systems. This yields a body of theory that is testable against observational and experimental evidence from the real-world people and objects modeled, as is done in the other hard sciences.

Assemblages of people and other real-world objects are modeled as systems called linkages. The communicative roles that the people and objects play in an assemblage are modeled as systems called role parts, prop parts, and link parts of the linkage that models the assemblage.

An observer is also a person and can also be modeled in HSL. Thus we make an important distinction between (1) an [observer] role part, a system in hard-science linguistics that models a person in the role of observer and is formally indicated by square brackets, and (2) an observing scientist, who observes in addition to theorizing, testing, and reporting as part of the world-wide scientific community (see Yngve 2004) and is normally designated by *we*, as in the beginning of this sentence. We have to be careful not to confuse the two. We also have to be careful not to confuse this scientific *we* with (3) the introspective philosophical *we*, as in 'how we communicate' (rather than 'how people communicate')

so prevalent in the soft sciences to mark introspective so-called observations and feelings, which we must reject in a hard science because they are subject to observer bias and cannot be verified reproducibly by others.

2. ORTHOCONCEPTS IN AN OBSERVER. In order to find out more about the role of an observer in hard-science linguistics, we turned again last year to the example of the game of tag (Yngve 1996, ch. 13) and asked what an observer of the game of tag would observe. The initial results were set forth in a LACUS paper last year. It led to the introduction of orthoconcepts.

An observer observing the elementary children's communicative game of tag was modeled as an observer role part in an observing linkage in which the observed tag linkage is a link part.

(1) [observing linkage] = [observer] + [observed tag linkage]

Note that the observer can play an observing role part in the same linkage that is being observed.

This led to showing how orthoconcepts of the game of tag, the children playing tag, and who was 'it' would form in the observing role part of an observer who understands tag and other games. We called these orthoconcepts to distinguish them from the scientifically questionable approaches to concepts in the literature. Orthoconcepts are not freestanding abstractions. Orthoconcepts are properties in a theory of a real observer that model a physical reality and require an observer in which to form. This paper will go further and introduce some of the other advances that formalizing the observer brings to linguistics.[3]

3. THE OBSERVER AND THIRD PERSON DIALOG. In Yngve (2005) it was shown how to formalize in HSL how Butch, knowing his own name, could answer the query 'What's your name?' by saying 'Butch'. We now consider how to formalize a dialog involving the names of third persons. This requires that at least the first-person conversationalist take the additional simultaneous role of observer with orthoconcepts of what is observed.

Suppose we have a tag linkage with role parts for five children where Pat is 'it'. Following the latest notation, we have:

(2) [tag linkage] = [Alex] + [Butch] + [Chris] + [Pat]<it> + [Sam]

We set up an observing linkage [obs L] with Joel observing the tag linkage:

(3) [obs L] = [Joel] + [tag linkage]

The Joel role part, which models an observer who understands tag and other games, forms orthoconcepts of the tag linkage and of the tag-player role parts, with the Pat role part being <it>. Following (2) we formalize this in angle brackets, because here it is a property of the Joel role part:

(4) [Joel]< [tag linkage] = [Alex] + [Butch] + [Chris] + [Pat]<it> + [Sam] >

Joel should answer ‘Pat’ to Butch’s question of ‘Who’s “it”?’ For this we need a search procedure in the Joel role part by analogy to an expectation procedure for inputs. It would search over orthoconcepts with their expected properties in an observer rather than searching over sounds expected by a hearer.

We formalize this as a procedure in the [Joel] observer role part that searches simultaneously in parallel over his orthoconcepts of the tag players and their expected properties, searching for the one with the property <it>.

(5) [Joel]<Lsearch><tag linkage> = <expect
([Alex]<it> -> <emit sound of ‘Alex’> ->)
v ([Butch]<it> -> <emit sound of ‘Butch’> ->)
v ([Chris]<it> -> <emit sound of ‘Chris’> ->)
v ([Pat]<it> -> <emit sound of ‘Pat’> ->)
v ([Sam]<it> -> <emit sound of ‘Sam’> ->)>

The critical procedure is called <Lsearch>, L for Lara Burazer because she had the idea that we needed such a procedure (personal communication, February–March, 2005). When it searches (simultaneously in parallel) over the orthoconcepts of the tag linkage role parts looking for the one with the property <it>, it finds a match with [Pat]<it> and then emits the sound of ‘Pat’, which answers the query “Who’s ‘it’?”

4. CONNOTATIONS AND THE VARIATION OF ‘SUBMARINE SANDWICH’.[4] A frequently used example of linguistic variation is that of the submarine sandwich, which is reported to vary regionally in the U.S. between *sub*, *hoagie*, *grinder*, *guinea*, *hero*, *Italian*, *Italian sandwich*, *Cuban sandwich*, *poor boy*, *po’ jo*, *torpedo*, *wedge*, and *zep*.[5]

Let us take as a beginning a fast-food restaurant linkage [FF] with a prop part for a sandwich and role parts for a clerk and a customer.

(6) [FF] = [sandwich] + [clerk] + [customer]

The customer says to the clerk ‘Give me a…’. For the clerk we have:

(7) [clerk]<expect a food name> = <(sound heard from customer)> + <expect
sound of ‘grinder’ v ‘hoagie’ v ‘hero’> -> <match> N <try again> Y ->

If there is a match with one of the variants of the name of the sandwich that the clerk knows, this can trigger procedures in the clerk for getting the sandwich for the customer.

There would also be included other expectation procedures <expect sound of…> and their paired <match> procedures for other items on the menu that the clerk recognizes.

A traditional approach would probably see these things as dealing with what it calls ‘denotation’. Actually getting the requested sandwich, although it answers to the request,

would not be treated at all but brushed aside as an aspect of language use, another impossible concept with a built-in confusion between the logical domain (language) and the physical domain (use). But we don't need to bow to the tradition in any way unless we wish to, since we have already formalized the crucial function in the linkage of the triggering of procedures in the clerk for getting the correct sandwich for the customer.

Now let us consider what an observer of the fast-food assemblage can do. We set up an observing linkage [obs-L] with a role part for the observer and a link part [FF] for the fast-food restaurant linkage:

(8) [obs-L] = [observer] + [FF]

The [observer] has an orthoconcept for a prop-part [sandwich] with several name properties and their regional variants:

(9) [observer]< [sandwich]
<name/grinder/Region/NewEng>
<name/hoagie/Region/PA-NJ>
<name/hero/Region/Prob NYC> >

Although these variants could be the results of an investigation in linguistic geography, they are understood by the observer in our example as regional connotations of the variants.

In comparison with the ancient philosophical tradition of 'thing–concept–name', we have here a scientifically justified theory: First there is the real-world sandwich (the 'thing'), which is a given object of study. HSL then formalizes as part of the properties of the observer an orthoconcept of the sandwich (the 'concept') with a name (or names) as properties of the orthoconcept (the 'name') and their connotations for good measure. These are quite different from the traditional logical-domain abstractions: They are all in the physical domain and a part of standard hard science. And for his we need only the two standard criteria and the four standard assumptions of the hard sciences (see note 1). Previously troubling and confounding domain confusions vanish. And in answer to anyone who may still think there is an ideal in language of one word one meaning, HSL recognizes and treats variation, as we have shown, which actually is the usual case.

We also have in the observer role part of the fast-food linkage a monitoring procedure executing simultaneously in parallel with the procedure in the clerk role part. We formalize it in (10):

(10) [observer]<expect a food name> = <(sound heard from customer)> + <expect sound of
('grinder'> <match> Y -> <gather><Region/NewEng>
v 'hoagie'> <match> Y -> <gather><Region/PA-NJ>
v 'hero'> <match> Y -> <gather><Region/Prob NYC>) N <try again> ->

Here if the sound heard matches one of the simultaneously executing parallel branches of the expectation procedure, the observer has recognized and identified one of the regional variants, and along with this he gathers its regional associations. If there is no match the observer has not recognized a sandwich name and will try again. An observer who is a linguist might glean from this some information about the details of the linguistic variation involved.

The role of the observer is essential, and in an observer, expectations of what might be observed are crucial. This can only be formalized in hard-science linguistics. Note that this formalism is much different from a frequent view of perception which is passive rather than active and does not take expectations into account.

Of course the clerk could act as an observer of the fast-food assemblage that he is a participant in. In this case he would also observe himself acting as the clerk.

For this, besides the fast-food linkage of (6) above repeated as (11):

(11) [FF] = [sandwich] + [clerk] + [customer]

we also set up a linkage (12) to cover the clerk as observer :

(12) [clerk-obs] + [FF]

When the customer says: 'give me a ...', we have the clerking procedure of (7) (repeated as (13):

(13) [clerk]<expect a food name> = <(sound heard from customer)> + <expect sound of 'grinder' v 'hoagie' v 'hero'> -> <match> N <try again> Y ->

We also have an observing procedure in the clerk-observer executing simultaneously and in parallel in the same person similar to (10) above.

(14) [clerk-obs]<expect a food name> = <(sound heard from customer)> + <expect sound of
('grinder'> <match> Y -> <gather><Region/NewEng>
v 'hoagie'> <match> Y -> <gather><Region/PA-NJ>
v 'hero'> <match> Y -> <gather><Region/Prob NYC>)
N <try again>->

If there is a match with the sound of 'hoagie', the clerk-observer will hear with this observing procedure and also understand: Region/PA-NJ. This does not interfere at all with his understanding what the customer wants, as in (13), but it adds an understanding that the customer is from the Pennsylvania-New Jersey region, so there would be added to his [customer] orthoconcept a property <Region/PA-NJ>, as in (15)

(15) -> [clerk-obs]<customer/Region/PA-NJ

We could say that he attributes a Pennsylvania-New Jersey way of speaking to the customer or predicates it of his concept of the customer. We might even say that for him 'hoagie' connotes a Pennsylvania-New Jersey way of speaking.

Now to connote, to predicate, and to attribute are terms in the tradition. It is not necessary to introduce them as terms in HSL because we have already formalized everything that we need here having to do with how people communicate. The traditional names add nothing except perhaps to suggest to people familiar with the tradition something of the significance of what we have done.

So, not only does formalizing the observer give us 'concepts' (orthoconcepts) in the observer of what is being observed, it gives us the 'attribution' or 'predication' of properties added to these orthoconcepts, properties that the observer expects and confirms in expectation procedures executed during the observing (here hearing). The properties that get 'predicated' here come from 'connotations', but they don't have to. They could come from any property expected as a result of hearing or seeing etc.

5. NICKNAMES AND DIMINUTIVES. As another example of variation, suppose we have a man, John Smith, who is known formally as 'John' but is known as 'Johnny' in his family, 'Jack' at school, and 'Smitty' at work.

This is more complex than the example of *sub* because it not only involves what various people call him but what names he answers to.

We can set up four different linkages, [formal], [family], [school], and [work], in which John Smith plays four different role parts, [customer], [brother], [student], and [worker]. He has a different name in each, as above.

Writing down the relevant linkage for [formal] complete with the role-part properties, we have (16).

(16) [formal] = [observer] + [clerk] + [customer]<name/John>

If John Smith were asked his name, the observer would note that he would reply 'John'.

Analogously one could write down procedures for the other linkages for family, friends, and work, where he would reply 'Johnny', 'Jack' and 'Smitty'. And in a dialog starting with someone calling his name, there would be no problem. He would expect the appropriate name and answer to it. Since the role part would expect and reply with the appropriate plex expectations and procedures, there would be no need for what some theoreticians have inelegantly dubbed disambiguation.

For example, a visitor at school, where he is called 'Jack', says 'Hi, Jack' and the student answers 'hi'. We formalize this in (17).

(17) [school] = [observer] + [visitor] + [student]<name/Jack>
[visitor]<emit sound of 'hi'>
[student]<expect greeting> = <(sound heard)> + <expect sound of 'Hi'> ->
<match> N <try again> Y -> <hear sound of 'Hi'>
[visitor]<emit sound of 'Jack'>

[student]<expect name> = <(sound heard)> + <expect sound of 'Jack'> ->
<match> N <try again> Y <emit sound of 'Hi'>

So he answers to 'Jack' with no regard for 'John', 'Johnny', or 'Smitty'. Understanding in context is relative to the the plex of the currently executing role part in the current linkage.

How about the case of observing him addressed, unexpectedly, by his work name 'Smitty' at school, where he expects 'Jack'? This would lead to a <try again>, as in (18).

(18) [school] = [observer] + [visitor] + [student]<name/Jack>
[visitor]<emit sound of 'hi'>
[student]<expect greeting> = <(sound heard)> + <expect sound of 'Hi'> ->
<match> N <try again> Y -> <hear sound of 'Hi'>
[visitor]<emit sound of 'Smitty'>
[student]<expect name> = <(sound heard)> + <expect sound of 'Jack'> ->
<match> N <try again>

The school expectations have failed here, but he participates in several other separate and disjoint linkages in separate role parts. He will have to search over them all. The sound of 'Smitty' is still remembered in echoic memory, so:

(19) <try again> = <try formal> -> <try family> -> <try work>

<try formal> requires that he switch role part plex structures from school to formal:

(20) [formal] = [observer] + [visitor] + [customer]<name/John>
<expect sound of 'John'> -> <match> N ->

<try family>
[family] = [observer] + [visitor] + [brother]<name/Johnny>
<expect sound of 'Johnny'> -> <match> N ->

<try work> =
[work] = [observer] + [visitor] + [worker]<name/Smitty>
<expect sound of 'Smitty'> -> <match> N <try again> Y <emit sound of 'Hi'>

There is a match here so he answers to the name. He is still at school but is left with the work plex structure also active and this includes the work associations of 'Smitty'. He will probably try to 'place' the visitor there or try to understand why the visitor is bringing in an allusion to work.

Another possibility is that instead of searching sequentially one at a time through all four role-part plex structures, he searches them all at the same time in parallel by searching in the circle that encompasses all four linkages.

For this we set up a superordinate linkage [Smith circle] with a [John Smith] role part having properties for all four of his names in his role parts in the four linkages [formal], [family], [school], and [work]. <expect name> will search in this circle as in (21):

(21) [Smith circle] = [observer] + visitor] + [John Smith]
<name/John/linkage/formal>
<name/Johnny/linkage/family>
<name/Jack/linkage/friends>
<name/Smitty/linkage/work>

[visitor]<emit sound of ‘hi’>
[John Smith]<expect greeting> = <(sound heard)> + <expect sound of ‘Hi’> ->
<match> N <try again> Y -> <hear sound of ‘Hi’>
[visitor]<emit sound of ‘Smitty’>
[John Smith]<expect name> = <(sound heard)> + <expect sound of ‘John’ v
‘Johnny’ v ‘Jack’ v Smitty’> -> <match> N <try again> Y <emit sound of ‘Hi’>

There will be a match with ‘Smitty’, one of the alternatives, and John Smith will answer to it.

At the same time a monitoring procedure would search in parallel and gather information about how he knows the visitor as in (22):

(22) [John Smith]<expect name> = <(sound heard from visitor)> + <expect sound of
(‘John’> <match> Y -> <gather><linkage/formal> ->
v ‘Johnny’> <match> Y -> <gather>linkage/family> ->
v ‘Jack’> <match> Y -> <gather><linkage/school> ->
v ‘Smitty’> <match> Y -> <gather><linkage/work> ->)
N <try again> ->

These two alternative theories of how people hear and answer to names can lead to two specific psycholinguistic hypotheses that could be tested against evidence from real people. There already is some informal evidence that there are observable time differences involved in switching role-part plex structures.

6. CONCLUSION. This paper has presented twelve advances in theory that are unexpected benefits from formalizing the observer in addition to the four presented in Yngve 2005 in a paper dedicated to Adam Makkai.[6]

To summarize, the twelve advances in theory of formalizing the observer presented here are listed in (A1)–(A12).

(A1) We have formalized searching over orthoconcepts in an observer by <Lsearch> in analogy to recognizing the sounds of speaking by searching over sounds expected, as in hard-science phonetics-phonology.

(A2) We have formalized recognizing the names of third persons in dialog.
(A3) We have formalized hard-science replacements for denotations.
(A4) We have formalized hard-science replacements for connotations in an observer.
(A5) We have shown how regional variation can be handled.
(A6) We have shown how the regional connotations associated with that variation can be handled.
(A7) We have formalized monitoring by an observer role part.
(A8) We have formalize gathering from the context.
(A9) We have formalized the predicating and attributing of connotations.
(A10) We have investigated the social-contextual connotations of nicknames and diminutives.
(A11) We have modeled trying again in recognition.
(A12) We have pointed out the possibility of a psycholinguistic test of theory by timing tests of recognizing.

These unexpected advances in theory accrue to hard-science linguistics through its unique real-world physical-domain ability to formalize the observer.

Some of us are convinced that participants must be observers of the linkages in which they take part, that many aspects of their communicative behavior cannot be otherwise explained. This may well be true, but at present it is an unproved hunch, so perhaps 'must' is too strong. Hunches are important in the advancement of science. To make a specific argument for this might be difficult unless one reduced its scope to considering particular cases, but then to try to generalize from them might be problematic. Perhaps it could be approached through the important, perhaps essential, task of monitoring.

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1 The four standard assumptions of science are: (1) reality, that there actually is a real world out there to be studied; (2) coherence, that the world is coherent and regular so we have a chance of finding out something about it; (3) rationality, that we can reach a valid conclusion by reasoning from valid premises—that we can trust our ability to calculate predictions from our theories for comparison with the real world; and (4) causality, that observed effects flow from immediate real-world causes.

The two standard criteria of science are: (1) acceptance of theory; the standard criterion for acceptance of hypotheses or theories in science when doubts arise is the ability of their predictions to pass tests against the real world by means of careful observations and experiments; and (2) acceptance of observations; the standard criterion for acceptance of observational and experimental results in science is their replicability when questioned.

2 For those who would like to find out more about hard-science linguistics, ample educational materials are available. There are three books suitable as texts (Yngve 1986, 1996; Yngve & Wąsik 2004) and numerous papers that treat a rapidly expanding list of topics. Note particularly there and in the LACUS Forum volumes the work of Lara Burazer, instrumental in developing the important procedure <Lsearch>, who has done work on referring and apologizing; the work of Douglas W. Coleman on applied linguistics and second language learning and his work on testing hard-science linguistics theories using what have become known as Coleman simulators; and the work of Bernard Sypniewski, who issued Bernard's challenge to anyone who would show him a

real morpheme that he could hold in his hands and study. He has done work on pragmatics and the theories of John L. Austin, including lottery betting, jury verdicts, and gay marriage. There is a growing friendly and collegial HSL community to provide support and encouragement. A new book is now planned, edited by Douglas W. Coleman and Victor H. Yngve, that offers an outlet for publishing HSL work.

3 In hard-science linguistics there is no empty formalizing for its own sake, but rather formalizing to be explicit about the theory so we can calculate its predictions for comparison with real-world evidence.

4 I thank Connie Eble for her generous help with this topic. She may or may not agree with what I have done with it.

5 Found on the internet. Many of these terms are discussed in Metcalf (2000). The examples used here have been selected from the published volumes of *Dictionary of American Regional English* (1985–1996) and its included maps.

6 The four advances in theory presented last year were (1) how formalizing the observer leads to a hard-science replacement for concepts, which we called 'orthoconcepts' to avoid confusion with traditional concepts of concepts. This, added to (2) a proper hard-science handling of names, led to (3) a hard-science replacement for the traditional concept of a sign (thing–concept–name); and as a welcome bonus, (4) The easy handling of numerical values of real-world objects.

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IV

LEXICON, GRAMMAR AND DISCOURSE

THE EVOLUTION OF CLITIC SYSTEMS: A LEXICALIZATION EXPLANATION

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THE CLITICS DISCUSSED in this paper are mainly object pronouns and auxiliary verbs.[1] The evolution of the clitic systems in question—as shown in (1)—comprises the transformation of second position (2P) systems (such as those of Latin, Old Church Slavic, and modern Serbian and Croatian) into verb-adjacent clitic systems (such as those of French, Spanish, Bulgarian and Macedonian),[2] and the subsequent development of verb-adjacent clitics into verb-affixes.

(1)	A		B		C		D		E
	Independent Words	→	2P clitics (word-based)	→	2P clitics (constituent-based)	→	Verb clitics	→	Verb affixes

1. THE EVOLUTION FROM STAGE B TO E. For reasons that will become apparent in the course of the paper, stages B to E in (1) will be discussed starting with E and working backwards. Stage E is illustrated by the future tense suffixes of French. Thus French *fera* '(he/she/it) will do/make' derives ultimately from the Vulgar Latin compound form *facere habet* (Harris 1978:145):

(2) Vulgar Latin *facere habet* → Modern French *fer-a* '(he/she/it) will do/make'

Similarly, in the Russian of (3), *-ся* /sja/ 'self' is now a verb-suffix rather than an independent reflexive pronoun (Jakobson 1971:19–20):[3]

(3) брить-ся /brit'-sja/ [Rus]
to shave-self
'to shave (oneself)'

Stage D is illustrated by the French example (4)a. By contrast, (4)b—with its (italicized) clitics at 2P rather than adjacent to the verb—is ungrammatical, and thus shows that French clitics cannot occur in second position (2P) if this involves separating them from the verb.

(4)	a. D'habitude	Pierre	*me*	*l'*	achète	le	lundi	[Fre]
	usually	Peter	[to] me	it	buys	the	Monday	

(4) b. *D'habitude *me* *le* Pierre achète le lundi [Fre]
usually [to] me it Peter buys the Monday
'Usually Peter buys it for me on Mondays'

Stage C, with clitics after the first constituent, is illustrated by Slovenian example (5)a, in which the 3rd person singular clitic auxiliary *je* follows the first syntactic constituent, the noun phrase *njegov obraz* 'his face'; and (5)b—in which the clitic is adjacent to the main verb *pordel* 'reddened' rather than at 2P—is ungrammatical in modern spoken or written prose, though such word orders can be encountered in poetry. (The additional ungrammatical example (5)c is contrasted with Croatian example (7), discussed below.)

(5) a. Njegov obraz *je* v trenutku škrlatno pordel [Sln]
his face aux.3sg in instant scarlet reddened
b. *Njegov obraz v trenutku škrlatno *je* pordel [Sln]
his face in instant scarlet aux.3sg reddened
c. *Njegov *je* obraz v trenutku škrlatno pordel [Sln]
his aux.3sg face in instant scarlet reddened
'Instantly his face turned scarlet'

Stage B, at which clitics may interrupt a clause-initial complex constituent by being attached to the first word, is the earlier stage (Benacchio & Renzi 1987:5, Bennett 2002:174) illustrated by the Latin example in (6) and the modern Croatian example in (7)—where, however, the possibility also exists of placing the clitic cluster *će vam* after the whole noun phrase *moj sluga* 'my servant':

(6) Populus *se* Romanus erexit [Lat]
people itself Roman raised
'The Roman people rose up'
(7) Moj *će* *vam* sluga dati rječnik [Cro]
my will to-you servant give dictionary
'My servant will give you the dictionary'

Comparable examples to (7) for Slovenian may be found in early texts (Stone 1996:217) and might still be encountered in poetry. However, they do not occur in modern Slovenian prose or spoken Slovenian; thus (5)c is marked as ungrammatical.

2. LEXICALIZATION. 'Lexicalization' in the title of the paper can be clarified by reference to Lamb (1999:163–70, 179, 271), together with information about the frequency of occurrence of particular English words. Lamb notes (163) that even though a word such as *happiness* can be understood on the basis of the meanings of its constituent morphemes, the frequency with which this combination occurs is such that the lexicon of the typical speaker will contain not just the separate lexemes *happy* and *-ness* but also a complex lexeme *happiness*. Moreover, for this to be the case it is unnecessary for the meaning of *happiness* to be

in any way idiomatic: 'it is repeated use rather than degree of idiomaticity that determines presence or absence of a higher-level lexical [node]' (165, 271). Furthermore, the more frequently any part of the linguistic network (or wider cognitive network) is used, the easier it is to use it again: 'The pathways of the brain are like pathways through a meadow or field or jungle—the more they are used the easier they become to use again' (179). In formalizing this phenomenon in Relational Network Grammar (RNG), lines of different strengths are used (e.g. they are drawn with different thicknesses) and it is assumed that the strengths of the lines corresponding to frequently used items will increase over time. A Google search on the words *happy*, *happiness*, *full* and *fullness*, carried out on July 5, 2005, revealed that while the word *happiness* was only 7 times less frequent than *happy*, *fullness* was 443 times less frequent than *full*. If these figures are representative of a typical speaker's receptive and productive experience with the words in question, it seems reasonable to assume that he/she might either have no single node corresponding to the word *fullness* or, at least, that its connections would be rather weak compared with those of *happiness*.

3. UNIDIRECTIONALITY. The evolution of clitic systems is essentially unidirectional, as shown in (1). Thus, while there is ample evidence of 2P clitics becoming verb-adjacent clitics, there are no known examples of verb-adjacent clitics becoming 2P clitics. Lexicalization is similarly unidirectional and this fact is one reason for contemplating explaining the evolution of clitic systems in terms of lexicalization. However, certain qualifications of unidirectionality need to be mentioned. First, (bound) affixes may come to be used as (free) roots, as with the derivational affix in 'communism, capitalism and other *isms*' and the inflectional affix in '*-ing* verbs'. Secondly, in section 6 we shall see that the gradual loss of the possibility of interrupting complex constituents with a clitic cluster—cf. change B → C in (1)—can be reversed in special circumstances.

4. THE HYPOTHESIS OF THIS PAPER. The evolution of clitic systems seems to break down naturally into the three separate transitions B → C, C → D, and D → E of (1). It is a fairly obvious suggestion that the affixation involved in D → E might involve lexicalization in the sense of section 2. For instance, it seems possible that some Russian reflexive verbs may have come to be represented by single nodes in a RNG of the kind envisaged by Lamb, for the same reason and in the same way as has been hypothesized for words such as *happiness*. To investigate this possibility further, a Google search was carried out (on December 8, 2005) on the Russian verbs *брить* /brit'/ 'to shave', *пугать* /pugat'/ 'to frighten', and *досадить* /dosadit'/ 'to annoy'; and their corresponding reflexives *бриться* /brit'-sja/ 'to shave (oneself)', *пугаться* /pugat'-sja/ 'to be frightened', and *досадиться* /dosadit'-sja/ 'to annoy oneself'. The frequencies in question are shown in **Table 1** (overleaf).

As might well have been predicted (in view of the fact that most men shave themselves), (a.ii) is somewhat more frequent than its non-reflexive counterpart. In (b), by contrast, the non-reflexive verb is 3½ times more frequent than its reflexive counterpart. Nevertheless, the reflexive verb *пугаться* /pugat'-sja/ has a high frequency of occurrence; and the reason for this is that its customary meaning is 'to be frightened' rather than 'to frighten oneself'. (If the latter were the only possible meaning, the verb would presumably be considerably

		Verb	Occurrences
a	i	брить /brit'/ 'to shave'	67,600
	ii	бриться /brit'-sja/ 'to shave (oneself)'	84,100
b	i	пугать /pugat'/ 'to frighten'	396,000
	ii	пугаться /pugat'-sja/ 'to be frightened'	112,000
c	i	досадить /dosadit'/ 'to annoy'	39,400
	ii	досадиться /dosadit'-sja/ 'to annoy oneself'	18

Table 1. *Google frequencies (December 8, 2005) for six Russian verbs.*

less frequent.) The reflexive verb in (c.ii) can only mean 'to annoy oneself', not '*to be annoyed'. (To express the latter meaning, there is a separate verb *досадовать* /dosadovat'/.) At any rate, the reflexive verb in (c.ii) is 2,189 times less frequent than its non-reflexive counterpart.

We can conclude from the figures in **Table 1** that it is extremely unlikely that native speakers of Russian store *досадиться* /dosadit'-sja/ 'to annoy oneself' as a single (lexemic) unit. It is far likelier, however, that *бриться* /brit'-sja/ 'to shave (oneself)' and *пугаться* /pugat'-sja/ 'to be frightened' do have the status of single lexemes.[4]

One of the anonymous referees of this paper suggested that it would make sense to investigate the valency of verbs such as those in **Table 1**. This is a good suggestion. However, it is one that I shall not follow up here, since our main concern in the remainder of the paper will be to consider the possibility that all three transitions D → E, C → D, and B → C can be explained as involving lexicalization, and that we are therefore dealing with a single uniform process from B to E rather than three discrete transitions. This is the hypothesis of the present paper. Moreover, it seems reasonable to assume, by way of testing the hypothesis, that it should be possible to find textual evidence of such an ongoing process from languages located at particular points along the scale in question. This possibility will be examined in relation to transitions C → D and B → C in sections 5 and 6.

5. TEXTUAL EVIDENCE FOR THE TRANSITION C → D. Polish provides a good source of data in the present context, in that the last five hundred years of its history have exhibited 'a gradual drift from one ordered state—person and number markers in clause-second position—towards another ordered state—person and number markers as [verb] desinences' (Andersen 1987:41, summarizing the findings of Rittel 1975). It is appropriate to outline the facts in question before providing the promised evidence of lexicalization.

Rittel examined textual evidence from this period in connection with two verb-forms incorporating the active past participle (the *-l* participle): the past tense and the conditional. Because the change in question is not complete, variation can be encountered in the present-day language such as that in (8), taken from a Polish translation of George Orwell's *Nineteen-Eighty Four* and illustrating the past tense:

(a) 2P-placement (≠ verb-attachment)	(b) 2P-placement/ verb-attachment	(c) verb-attachment (≠ 2P-placement)
2 (2%)	29 (33%)	57 (65%)

Table 2. *Figures (and percentages) of person-and-number markers in the Polish past tense that were (a) unambiguously at 2P, (b) ambiguously at 2P and attached to the* -l *participle, and (c) unambiguously attached to the* -l *participle (in approximately 20,000 words of the Polish translation of George Orwell's* Nineteen Eighty-Four*; 88 examples altogether).*

(8)	Ty-*ś*	to	wiedział…	ty	to	zawsze	wiedział-*eś*[5]	[Pol]
	you-aux.2sg	this	known.masc.	you	this	always	known.masc-aux.2sg	
	'You knew this…			you have always known it'				

The first clause in (8) represents the older 2P word order for the (clitic) person-and-number marker, while the second clause represents the innovating word order with the clitic attached to the participle. Rittel's percentages for agglutination to the participle show a gradual increase, century by century, from 23% for the 1500s, via 49% for the 1600s, 68% for the 1700s, and 80% for the 1800s, to 84% and 92% for two different types of texts from the 1900s (Andersen 1987:29). However, Andersen draws attention to the problem that Rittel did not distinguish between cases where the *-l* participle to which the clitics were attached was in clause-initial position and cases where it occurred later in a clause. Andersen assumes that in the earlier centuries, when deviations from 2P placement would have been fewer, the majority of cases of 'agglutination to the verb' would have involved attachment of the clitics to clause-initial *-l* forms. In investigating this matter for the present-day language, I looked at approximately 20,000 words of the Polish translation of *Nineteen-Eighty Four*, and was concerned to count not only unambiguous examples of 2P placement and verb-adjacent placement, as in the two separate clauses of (8), but also examples that simultaneously involve 2P placement and attachment to the verb, such as (9):

(9)	Przyszli-*śmy*	tu…	[Pol]
	come-1pl	here	
	'We have come here …'		

Table 2 gives the relevant figures and percentages.[6]

Although the text revealed very few examples of person-and-number markers occurring at 2P separated from their *-l* participle, 33% of the examples were cases of verb attachment that were simultaneously at 2P. Nevertheless I am inclined to agree with Andersen (1987:41) that: 'the development as a whole is so far along… that its end point is… plain to see', i.e. that the Polish clitic system is well on the way to becoming a verb-adjacent clitic system.

The conditional verb-form, illustrated in (10)—(11), lags some way behind the past tense, but 'from the 1700's on, the conditional enclitic complex (*by* + person and number-marker) begins to gravitate out of clause-second position [see (10)] and towards agglutination to the *l*-form [see (11)]' (Andersen 1987:35).

(10) A ja *by-m* nie zatrzymała [Pol]
but I would-1sg not keep
'But I wouldn't keep [it]'

(11) W takim wypadku zmianie uległa-*by* jego twarz [Pol]
in such event to-change succomb-would his face
'In such an event, his face would undergo change'

The relevance of these facts for the lexicalization hypothesis becomes clear when we discover—cf. Andersen (1987:35), reporting Rittel's (1975:120, 146) discussion—that the earliest participles to attract the person-and-number markers away from 2P are: *był, został, miał, mógł,* and *chciał*, from the verbs meaning 'be', 'become', 'have', 'be able to' and 'want', which are among the most frequently used verbs in the language. All the Slavic languages had the possibility of beginning a sentence with an *-l* participle followed by an auxiliary. What seems to have happened in Polish, then, is that the most frequent participles tended to take their auxiliary with them when they occurred at some later position in a sentence. This is precisely what the lexicalization hypothesis would predict.

Rittel points out, in addition, that migration of the auxiliary of the conditional away from 2P 'is strongly disfavored by the occurrence of conjunctions in clause-initial position' (Andersen 1987:35, paraphrasing Rittel 1975:143), and Andersen adds (*ibid.*) that 'agglutination [to the participle] is far and away more common in main clauses than in subordinate clauses'. A relevant example is provided in (12):

(12) jak-*by* *go* ktoś zdzielił pałką gumową po ciemieniu [Pol]
as-would him somebody impart stick rubber on temple
'as if someone imparted him [a blow] with a rubber truncheon'

Under the lexicalization hypothesis, the explanation for this would be that some conjunctions exhibit a still greater degree of lexicalization with the auxiliary of the conditional than even the most frequent verbs. This would seem to be confirmed by the fact that dictionaries of Polish have an entry not only for *jak*, meaning 'how; as; if; than' but also for *jakby* as a compound conjunction, meaning 'as if; if'. Another similar pair is *gdy* 'when; as; that' and *gdyby* 'if'.

6. TEXTUAL EVIDENCE FOR THE TRANSITION B → C. The above discussion of Polish data involves the transition C → D of (1). We need now to turn to the transition B → C, i.e., the loss of the ability for clitics to interrupt, or split, a complex syntactic constituent. In the absence of historical evidence from Slovenian to shed light on how split constituents died out in this language, the approach adopted here involved using Google to determine the frequency of particular Serbian and Croatian expressions within Google's corpus of texts. Four examples of split constituents, taken from the Serbian and Croatian translations of Orwell's *Nineteen Eighty-Four*, are given as (13)—(16). The split constituents are highlighted in bold.

		Search string	Occurrences
a	i	"ove se dane"	5
	ii	"ove dane se"	54
b	i	"jedan je helikopter"	6
	ii	"jedan helikopter je"	17
c	i	"čije su fasade"	19
	ii	"čije fasade su"	3
d	i	"sve je to"	c. 81,500
	ii	"sve to je"	c. 11,400

Table 3. *Google frequencies (July 21, 2005) for particular Serbian and Croatian expressions.*

(13) **ove** *se* **dane** električna struja za obdanice obustavljala [Cro]
these itself days electric current for daytimes suspended
'at present the electric current was cut off during daylight hours'

(14) U daljini **jedan** *je* **helikopter** skliznuo dolje… [Cro]
in distance one aux.3sg helicopter slipped down
'In the far distance a helicopter skimmed down …'

(15) **čije** *su* **fasade** bile poduprte gredama [Ser]
whose aux.3pl facades been supported with-beams
'their sides shored up with baulks of timber'

(16) **sve** *je* **to** ulivalo zebnju [Ser]
all aux.3sg that inspired anxiety
'everything was intimidating'

Table 3 shows Google's frequencies, on July 21 2005, for each of these four split constituents and the corresponding combinations with the clitic following the constituent in question. Clitics in both languages may also occur later in their sentence than immediately after the highlighted constituents, but my hypothesis was that wherever else they would occur, the combination in which they occurred was likely to be more frequent than that in which they occurred when they interrupted a complex constituent. In other words, the hypothesis was that, in preferring non-split structures, speakers would be opting for more frequent structures. This is indeed how things look in (a) and (b) in **Table 3**, even though the figures involved are quite small.

However, in (c) and (d) the split constituents turned out to be more frequent than their non-split counterparts. In (c), *čije* is a form of *čiji*, meaning 'whose'. It functions as an interrogative or a relative pronominal adjective, and typically occurs in clause-initial position. Its occurrence in this position with a clitic cluster at 2P is reminiscent of Polish *jakby* 'as if' in (12). It seems reasonable therefore to expect that clitics in this position might resist placement elsewhere, precisely because of the frequency of such clause-initial combinations. In this case the greater degree of lexicalization would encourage the clitic to remain at (word-based) 2P rather than to occur elsewhere. The same sort of explanation would apply also to *sve je to* in (d). Moreover, as speakers of Serbian and Croatian gradually lose the ability to split complex

	1905	1935	1965	1995
Serbian	56	5	3	5
Croatian	164	114	57	215

Table 4. *Clause-initial split constituents in newspaper texts (based on 1,000 examples of clitics for each year and language).*

constituents, one would predict that structures such as (c.i) and (d.i) would be retained longer than structures such as (a.i) and (b.i). It seems, then, that lexicalization has two alternative effects with examples such as those in (13)–(16) and **Table 3**. In the case of some expressions it favors the occurrence of clitics elsewhere than where they interrupt a complex constituent, but with other expressions it encourages the persistence of the split constituent. The history of Slovenian would lead one to predict, though, that Serbian and Croatian prose will eventually be free of interrupted complex constituents.

There is, however, a sociolinguistic factor that needs to be mentioned, involving standard languages and national identity. Over the last 150 years many discussions of Serbian and Croatian have regarded them as two variants of a single language, but equally many have regarded them as separate languages. With the break-up of former Yugoslavia there arose a new political situation. In this connection Reinkowski (2001) investigated the use of clitics in Serbian and Croatian throughout the twentieth century. She carried out textual analysis on Serbian and Croatian newspaper articles from the years 1905, 1935, 1965 and 1995. Specifically, her data consisted of 1,000 sentences from each year for each of Serbian and Croatian (8,000 examples altogether). **Table 4** gives the figures for split clause-initial complex constituents.

Three things emerge from these figures:

(a) Croatian, throughout the period in question, used more split constituents than Serbian. This was supported by my own figures from the separate Serbian and Croatian translations of Orwell's *Nineteen Eighty-Four*, where corresponding 5,500-word passages containing approximately 400 clitic clusters yielded 7 examples of split constituents for Serbian and 16 examples for Croatian.
(b) The use of split constituents was gradually declining throughout the period in both Serbian and Croatian... at least until 1965.
(c) 1995 (after the break-up of Yugoslavia) reveals a big increase in the number of split constituents in Croatian.

Writing in the 1990s, the Croatian linguists Barić *et al.* (1999:268) describe the splitting of complex constituents as a sign of a more careful style of Croatian, and it would seem that, for the moment at least, this feature of Croatian is on the increase again. One possible explanation for this is simply that sufficiently large numbers of Croats are aware of, and happy to accept, the opinion of linguists such as Barić and her associates. An alternative, or additional, possibility is that Croatian writers are conscious of the fact that the splitting of complex constituents by inserting a clitic cluster is more common in Croatian than

in Serbian, and therefore that the use of this structure provides a way of differentiating themselves linguistically from Serbs. In either case, the structure in question is above the level of consciousness of writers and speakers of the language, which opens up the possibility of reversing the otherwise expected change from B to C.

7. SUMMARY AND FURTHER DISCUSSION. This paper proposed the hypothesis that the whole of the evolution of clitic systems covered by B → E in (1) can be explained in terms of Lamb's (1999:163–70) conception of lexicalization, and provided textual evidence in support of this hypothesis in particular for the separate transitions C → D and B → C. Future work will need to examine what the implications of this diachronically oriented investigation are for the synchronic analysis of languages at different stages of the evolution.

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1 I am grateful to Monika Leeming for help in relation to Polish and Simona Bennett in relation to Slovenian, Serbian and Croatian. In addition, comments by William Sullivan after the oral presentation of the paper led to an improvement of section 5; and further improvements were suggested by the observations of three anonymous referees. It goes without saying that none of these is responsible for any defects that remain.

2 I am aware of problems with the term 'language', e.g. that 'languages' shade into one another rather than being discrete. Nevertheless it will be convenient in this paper to refer to Latin, French, Russian, etc., as 'languages'.

3 Wherever the reflexive suffix follows a vowel, it takes the form *-сь* /s'/—e.g. in *отличалось* / otličalo-s'/ '(it) differentiated itself'. Russian reflexive verbs will be briefly revisited in section 4.

4 William Sullivan informs me that there are also cases in Russian where a reflexive verb remains in the language but the corresponding non-reflexive verb has fallen into disuse—e.g. *казаться* /kazat'-sja/ 'to seem' vs. *казать* /kazat'/, which has been replaced by *говорить* /govorit'/ 'to speak, talk'.

5 In the feminine singular forms *wiedziałaś* and *wiedziała*, the *a* that occurs before *-ś* or word-finally is the feminine inflection on the *-l* participle. By contrast, the masculine singular inflection is realized sometimes as *e* (as in *wiedziałeś*) and sometimes as zero (as in *wiedział*). An alternative analysis (e.g. Spencer 1991:370–71) treats the *e* as an epenthetic vowel.

6 For comparison with Rittel's figures, which dealt only with person-and-number markers, I excluded all the examples of other clitics occurring either separated from or adjacent to an *-l* participle, e.g. *się* 'self', *mu* 'to him', and *go* 'him'. In addition, since the majority of instances of the past tense in the text as a whole are 3rd person forms, which have no overt person-and-number markers in either the singular or the plural, the passages that were examined consisted primarily of dialog, which provided sufficiently large numbers of 1st and 2nd person forms.

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MEASURING LEXICAL DISTRIBUTIONS ACROSS THEME AND RHEME

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THE SYSTEMIC-FUNCTIONAL DEFINITION of Theme and Rheme originated by M.A.K. Halliday involves both a semantic and a lexico-grammatical aspect. The Fries interpretation of this definition grounds the grammar in a discourse strategy potential. The analytical procedures offered here and elsewhere attempt to measure the ways in which this potential is realized in various typical and untypical stretches of text. The ultimate aim will be to generalize this potential in quantificational terms, leading to a description of the proportions of features which define the wordings of Theme and Rheme respectively.

1. SYSTEMIC-FUNCTIONAL THEME AND RHEME. The original Systemic-functional definition of Theme has been extensively reinterpreted. Halliday's 'what is being talked about, the point of departure for the clause as a message' (1967:212) has been recontextualized by Peter Fries, interpreting Theme as the basic means of realizing 'method of development' in texts. The aggregate of Themes, at least in a text segment with a simple method of development, functions to supply a consistent topical focus, and also to mark significant transitions in the outline structure of the text. That combination of consistency within an ordered variety of transitions, *is* the method of development (Fries 1981/83:116, 119, 121, 125, 135; 1994:234; 1995a:9, 1995b:58–62; 1995c:318, 323–26; 2002:125-26; Gómez-González 2001:98–100; Martin 1992:434–48, 1995:244–53; Matthiessen 1992:60–66, 1995:26–40). Furthermore, the Rheme is not just the residue of the message structure. It is the basic means of realizing the Point of the text. Particularly important is the N-rheme (N- for new), or clause final element, because it represents the default location of the Focus of New Information and is thus the average location for the new information which furthers the discourse (Fries 1981/83:128–29, 135; 1992:464, 478–79; 1993:338–39; 1994:232–34). Another finding is the recognition that the language of the method of development and the language of the Point are different. For example, the aggregate of Themes in some area of the text is apt to be relatively rich in presuming reference, i.e. reference which signifies that the identity of the participant is contextually recoverable (Fries 1981/83:124; 1994:230–31; 2002:122–23; Martin 1992:109). The aggregate of N-rhemes is apt to be richer and more various in its lexis (Martin 1992:452; 1993:244; Matthiessen 1995:43–44).[1]

In a previous LACUS paper and elsewhere (Cummings 2004; in press) I have suggested methods for defining the linguistic differences between Theme and Rheme on a quantitative basis, both to demonstrate them accurately and also to supply the basis for exact stylistic comparisons between texts. This may also lead to a definition of Theme which incorporates the probabilities of occurrence of its characteristic language features.

When next he looked up he realized that for some time he had been hearing neither song nor drums but a confused din not unlike the roar of a bull-fight: it was in fact a boxing-match. He had heard of the sport forever, but curiously enough he had never seen a formal contest – nothing more than scuffles among the boys in earlier commissions or dockside brawls. Yet this appeared to be a singular battle. He took up his small spyglass, never far from hand, and his first astonished impression was confirmed. There were two fine upstanding young women setting about one another with bare fists. Violent, whole-hearted blows, and judging from the cries of the onlookers, well given and well received. Clarissa was laughing; the little girls hardly knew how they liked it; some of the seamen and all of the islanders backed one girl or the other with the greatest zeal. Yet at the very climax, and for no reason that Stephen could see, when neither was giving an inch, the old chief beat the kava-bowl, an attendant blew on a conch, the chief's sister intervened, the two young women fell back and walked off, one rubbing her cheek, the other her bosom: there was a cry of disappointment from the seamen who had enjoyed it, but almost immediately afterwards, from one end of the line to the other, came baked hogs, baked dogs, fishes and fowls wrapped in leaves, yams, plantains, breadfruit.

Table 1. *Excerpt from Patrick O'Brian's* Clarissa Oakes *(HarperCollins, 1994), p. 178.*

In those studies, the quantitative approach has focused on the distribution of presuming reference (Martin 1992:109–15) among three parts of the clause in texts: the Theme, the N-rheme and the 'Other' part or remainder of the Rheme (Fries 1992:478). There are three types of quantitative index, all pertaining to reference chains, i.e. sequences of participants, each presuming the one(s) before (Martin 1992:140–41). The first is the relative percentage of reference chain elements that occur within Themes, Other or N-rhemes respectively within a given stretch of text. The second index is the number of chain elements divided by the total number of experiential (that is, propositional) elements in each of the three segments of the clauses, which yields the density of reference items within the experiential part of each of these segments. The third type of index, which relates only to longer chains, is itself threefold: (a) the proportion of long chain elements within the Themes, (b) the proportion of Theme elements which belong to the long chains, and (c) the multiplication product of both, as a convenient single index to the relevance of long chains to the method of development.

To illustrate the application of these measurements, **Table 1** offers one paragraph from Patrick O'Brian's sea yarn *Clarissa Oakes* (1994:178). In **Table 2** the passage has been lineated to distinguish individual clauses which are grammatically prominent, i.e. not embedded in groups. Vertical lines mark the boundary between Theme and Rheme, left brackets mark the boundary between Other and N-rheme parts of the Rheme. The Theme stretch is taken to include any Subject element occurring before its verb, even when preceded by a marked topical Theme (Cummings in press:129). Nominal groups which have non-esphoric presuming reference, i.e. not forward reference within the same nominal group (Martin 1992:123-24), and non-homophoric presuming reference, i.e. not reference to information retrievable from shared knowledge within the community (Martin 1992:121), and which are grammatically

1 When next **he** | [looked up

2 **he** | [realized

3 that for some time **he** | had been hearing [neither song nor drums but a confused din not unlike the roar of a bull-fight:

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4 **it** | was in fact [a boxing-match.

5 **He** | had heard of **the sport** [forever,

6 but curiously enough **he** | had never seen a formal contest – [nothing more than scuffles among the boys in earlier commissions or dockside brawls.

7 Yet **this** | appeared to be [a singular battle.

8 **He** | took up [**his small spyglass**, never far from hand,

9 and **his first astonished impression** | [was confirmed.

10 **There** | were [two fine upstanding young women setting about one another with bare fists.

Violent, wholehearted blows,

11 and |

12 | judging [from the cries of the onlookers,

(11) [well given and well received.

---

13 **Clarissa** | [was laughing;

14 **the little girls** | hardly [knew

15 how **they** | liked [**it**;

16 **some of the seamen** and **all of the islanders** | backed **one girl** or **the other** [with the greatest zeal.

---

17 Yet at **the very climax**, and for no reason that Stephen could see,

18 when **neither** | was giving [an inch,

(17) **the old chief** | beat [**the kava-bowl**,

19 an attendant | blew [on a conch,

20 **the chief's sister** | [intervened,

21 **the two young women** | [fell back and walked off,

22 **one** | rubbing [**her cheek**,

23 **the other** | [**her bosom**:

24 there | was [a cry of disappointment from the seamen who had enjoyed it,

25 but almost immediately afterwards, | from one end of the line to the other, came [baked hogs, baked dogs, fishes and fowls wrapped in leaves, yams, plantains, bread-fruit.

Table 2. *Theme, Other, N-rheme and reference chain elements in clauses.*

prominent, are bolded.[2] The method of development is organized into four parts. Themes in the first (lines 1–3) are dominated by Stephen references, in the second (4–12) by alternating Stephen and boxing match references, in the third (13-16) by a list of spectators, and in the fourth (17-25) by the human participants in the climax of the episode.

Table 3 (overleaf) is a table of proportions for the reference chain element distribution in this episode. Of the 30 such bolded reference chain elements, 73% belong to the Themes,

Ref. element distribution in:		
Theme	**Other**	**N-Rheme**
73%	10%	17%

Ref. element density in:		
Theme	**Other**	**N-Rheme**
73%	15%	20%

Long chain distribution:		
% in Themes	**% of Themes**	**Product**
70%	73%	0.511

Table 3. *Table for reference element distribution.*

17% to the N-rhemes, and 10% to the Other. The density of reference elements in Themes is 73% of experiential items, compared to 20% in N-rhemes and 15% in Other. As is known to happen in narrative genre especially (Francis 1989:211; Halliday 1994:336), there is a high proportion of the long-chain elements that go into Themes, 70%, and a high proportion of the Themes which contain long-chain elements, 73%. (Considered long are the *Stephen* chain with 8 elements; and the *fight*, *one* (young woman), and *other* (young woman) chains with 5 each.) This appears to be a classic pattern for the consistency aspect of the method of development in written modern English narrative discourse.

2. A QUANTITATIVE APPROACH TO LEXICAL VARIATION. Systemic-functional linguistics has also noted a complementary tendency to lexical richness and variety in the language of the Point of texts. Like the distribution of presuming reference, lexical variety can be represented and compared by a quantitative procedure. The main object of this paper is to present three different types of quantitative measurement which can be used to show the proportions of lexical variety within the Theme, N-rheme and Other stretches of consecutive clauses in a text segment. The first of these is a measurement of repetition density, i.e. the proportion, in any area of the text, of lexical items which are iterated. This relates to the variety of lexis inversely, since the use of lexical iteration, perhaps as an alternative to pro-forms, is to constrain variety. The second is the familiar concept of lexical density, in two forms: lexical density as such, and additionally, lexical word density, that is the proportion of lexical words, as opposed to lexemes, in any area of the text. The latter measures the number of lexical word items in a text divided by the total number of words in the text. The former perhaps serves the notion of lexical variety better because it counts not lexical word items but just lexis as such irrespective of iteration and morphological variation. This procedure yields lexical density as such, and is thus the ratio of the number of lexical items in this sense divided by the total number of words in the text. The third type of quantitative measurement is derived from a graphic representation of the semantics of the lexis in any area of

INDICES:	*Clarissa*		
	Theme	**Other**	**N-rheme**
1. word items	75	48	118
2. unrepeated lexical items	20	19	63
3. lexical word items	24	22	68
4. repetition density	17%	14%	7%
5. lexical items	23	21	65
6. lexical density	31%	44%	55%
7. lexical word density	32%	46%	58%
Graph Densities:			
8. THING	48%	33%	40%
9. PROCESS	17%	57%	40%
10. QUALITY	35%	10%	20%
11. agnation density	55%	61%	65%

Table 4. *Lexical and lexico-semantic densities.*

the text. This measurement determines, first, the relative proportions of items with THING, PROCESS or QUALITY semantics within the lexico-semantic graph for any area of the text; and, secondly, the agnation density, that is, the proportion within the graph of agnate relationships, i.e. between/among dependencies on the same node (Halliday & Matthiessen 2004:31; cf. Gleason 1965:201–14).

It is not hard to perceive that the Point, or information goals, of the *Clarissa* episode is realized in language which is lexically varied. An impression of this can be formed from the most consistent part of the aggregate of Rhemes, successive phrases for the boxing match: *neither song nor drums*, *a confused din*, *a boxing-match*, *the sport*, *a formal contest*, *a singular battle*, *two fine upstanding young women…*, and [*blows* understood]… *well given and well received*. **Table 4** is a table of lexical measurements across Themes and Rhemes. One obvious aspect of the richness of the lexis in the Rhemes is its sheer bulk: line 3 of the table indicates that 24 lexical words occur in Themes against 90 in Rhemes. Furthermore line 4 in the table shows that the repetition density of lexical items, i.e. the number of repeated lexical items divided by the number of lexical word items, is as high as 17% in Themes, as low as 7% in N-rhemes. Line 6 shows lexical density rising from 31% in Themes to 44% in Other to 55% in N-rhemes, and the figures for lexical word density on line 7 are similarly proportioned. This too appears to be a classic pattern for written modern English narrative discourse.

The third type of lexical measurement involves the semantic modelling of the lexis of a text segment as a lexical word net, or lexico-semantic graph. As the name implies, the net or graph is a network of semantic relationships among the individual lexical items of the text segment, based principally on relations of hyponymy and meronymy (part-whole—Halliday & Hasan 1985:81) obtaining between individual pairs of items in the graph, and seen

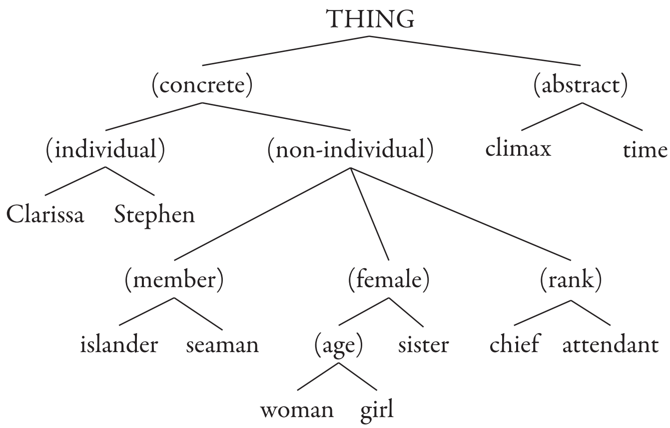

Figure 1. *Lexico-semantic graph for THING in Themes.*

to be transitive. The network of relations can be conceived as a set of edges linking together the lexical items as nodes, hence the term 'graph' (Cummings 1995:445; cf. Sowa 1983:29). It is postulated that the graph network would map together with a full Systemic-functional lexico-grammatical network which took these lexical items as its terminals.

The first type of measurement for lexical variety based on the lexico-semantic graph simply registers the proportions of lexical distribution among the three most general categories, THING, PROCESS and QUALITY. As an example, **Figure 1** shows the THING portion of the lexico-semantic graph for Themes in the *Clarissa* episode. In addition to the 11 nodes for actual lexical items, virtual nodes in parentheses complete the taxonomy. Table 4 shows on lines 8-10 that in Themes, the 11 lexical items for THINGS comprise 48% of the lexis, while PROCESSES have 17% and QUALITIES have 35%. This disproportion in Themes in favour of THINGS is matched by a similar disproportion in Other in favour of PROCESSES (57%). It is only when we get to the N-rhemes that proportions become more balanced. These proportions signify that a contribution made to lexical variation by relative balance among lexis types doesn't ensue until the very ends of the clauses on the whole, which is probably a variation from the normal patterning for written modern English narrative discourse.

The second type of measurement based on the graph is agnation density, the number of agnate relations divided by the number of nodes in the graph. To calculate the relative proportions of agnate relations in the graph, as another measure of lexical variety, each solitary dependency represents 0 agnates, and each additional agnate beyond that is counted as 1. Thus the agnates in **Figure 1** are rated at 10, among the 20 nodes. This calculation factors in all the implicit nodes in parentheses. Agnation density is an index of lexical variety in the sense that the multiplication of hyponyms or meronyms to the same superordinate (co-hyponymy and co-meronymy) represents further variation from the inheritance potential (features in common with the superordinate—Hudson 1984:14–19) of hyponymy and meronymy as such. Line 11 of **Table 4** shows the agnation density for the *Clarissa* episode, which modestly

Attractive women had a wonderful time in Paris that year. Few delegates had brought their wives; indeed, it had been expressly forbidden most of the junior ranks. "All the most beautiful & well dressed society ladies appear to have been brought over by the various Departments," wrote Hankey to his wife. "I do not know how they do their work, but in the evening they dance and sing and play bridge!" The puritanical suspected that worse was going on than bridge. An American female journalist traveled "with complete frankness and tremendous enthusiasm" with an Italian general. In the hotels where the delegations stayed, women wandered freely into men's rooms. A couple of Canadian Red Cross nurses who made quite a career of mistaking the number on the door and then refusing to leave had to be sent home. The war had appeared to have loosened the old inhibitions. "Vice is rampant in Paris," said Elinor Glyn severely. "Lesbians dine together openly, in groups of six sometimes, at Larue's… Men are the same. Nothing is sacred, nothing is hidden, not even vice and avarice."

Table 5. *Excerpt from Margaret MacMillan's* Paris 1919 *(Random House, 2003), p. 146.*

increases from Themes across Other to N-rhemes. This does suggest increasing variety in lexical contrasts, and might be part of the typical pattern for modern discourse.

3. STYLISTIC VARIATION. Another use for the quantitative procedures is to try to substantiate the intuition of stylistic variation in the construction of the method of development and the Point. **Table 5** contains a single paragraph from *Paris 1919* (MacMillan 2003:146) which represents a rather different style of narrative. The lineated and annotated version of this paragraph is in **Table 6** (overleaf). It has an obvious method of development, in four parts: lines 1-9 introduce the issue on neutral terms, and are divided between pure narrative, 1–3, and quoted source, 4–9; lines 10–21 evaluate the moral dimension of the issue, somewhat comically, and again are divided between a pure narrative, 10-15, and a quoted source, 16-21. But the Themes show little reference chaining or conjunction. Topical continuity is maintained largely through a lexical similarity chain of female persons and types.

Table 7 (overleaf) has the reference element distribution for this text segment. Whereas the *Clarissa* text has a massive disproportion of reference elements in favour of the Themes, this segment has a modest disproportion in favour of the N-rhemes. There are not many reference elements altogether, leading to very low density figures in all parts of the clauses, but the density of reference elements within the experiential elements of N-rhemes is the highest, at 33%. There are no long chains to speak of, but the longest, *Hankey* at 4 elements, occurs just once in Themes and this occurrence is just one of 5 reference elements in Themes. The long-chain product is minuscule.

The lexical distributions in **Table 8** (overleaf) are equally contrastive with the *Clarissa* text. The Rhemes have only about half again as much lexis as the Themes, and the repetition density between Themes and Rhemes is equal—with the N-rhemes having a higher repetition density than the Themes. Lexical density and lexical word density are only slightly higher in the Rhemes; the lexical density of the N-rhemes is virtually the same as that of the Themes. The graph representation of the *Paris 1919* lexis shows

1. Attractive women | had a wonderful time in **Paris** [**that year**.
2. Few delegates | had brought [**their wives**;
3. indeed, **it** | had been expressly forbidden [**most of the junior ranks**.

---

4. "All the most beautiful & well dressed society ladies | appear to have been brought over [by **the various Departments**,"
5. wrote **| Hankey** [to **his wife**.
6. "**I** | [do not know
7. how **they** | do [**their work**,
8. but in the evening **they** | [dance and sing
9. and | play [bridge!"

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10. The puritanical | [suspected
11. that worse | was going on [than bridge.
12. An American female journalist | traveled "with complete frankness and tremendous enthusiasm" [with an Italian general.
13. In the hotels where the delegations stayed, women | wandered freely [into men's rooms.
14. A couple of Canadian Red Cross nurses who made quite a career of mistaking the number on the door and then refusing to leave | had to be sent [home.
15. **The war |** had appeared to have loosened [the old inhibitions.

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16. "Vice | is rampant [in **Paris**,"
17. said **| Elinor Glyn** [severely.
18. "Lesbians | dine together openly, in groups of six sometimes, [at Larue's . . .
19. Men | are [the same.
20. Nothing | is [sacred,
21. nothing | is hidden, [not even vice and avarice."

Table 6. *Theme, Other, N-rheme and reference chain elements in clauses.*

the usual unbalanced predomination of THING in Themes, but this is matched by an at least equally unbalanced predomination of THING in the N-rhemes. Only in the Other part of the Rhemes is there something like a degree of balance, and therefore greater variety of lexis. The agnation densities for the three parts of the clauses are virtually indistinguishable, making for a uniform distribution of agnates throughout the text.

4. CONCLUSION. This study has noted the connections among the Systemic-functional concept of Theme and Rheme, the method of development and Point, and the language features associated with each half of these dichotomies. Techniques for measuring the exact proportions of some language features especially associated with the method of development were reviewed; techniques for measuring the exact proportions of lexical features especially associated with the Point of texts were proposed. These measurements were then used to demonstrate the difference between two text segments, one with a very typical, the other with an untypical method of development. The result provides a basis for the exact

Ref. element distribution in:		
Theme	Other	N-Rheme
33%	20%	47%

Ref. element density in:		
Theme	Other	N-Rheme
22%	12%	33%

Long chain distribution:		
% in Themes	% of Themes	Product
25%	20%	0.050

Table 7. *Reference element distribution.*

INDICES:	*Paris 1919*		
	Theme	Other	N-rheme
1. word items	73	57	51
2. unrepeated lexical items	32	28	23
3. lexical word items	36	30	27
4. repetition density	11%	7%	15%
5. lexical items	32	28	23
6. lexical density	44%	49%	45%
7. lexical word density	49%	53%	53%
Graph Densities:			
8. THING	59.4%	21.4%	60.0%
9. PROCESS	31.2%	39.3%	20.0%
10. QUALITY	9.4%	39.3%	20.0%
11. agnation density	57%	58%	56%

Table 8. *Lexical and lexico-semantic densities.*

description of the proportions of language features involved in discriminating Theme and Rheme in their discourse context.

1 An excellent summary of the Systemic-functional theory of Theme and Rheme can be found in Thompson (in press). For a dissenting view of the method of development, see Crompton (2004).

[2] For example, in **Table 2**, items such as *the onlookers* (12), *Stephen* (17), *the seamen* (24), *it* (24), *the line* (25), *the other* (25) are not considered parts of the presuming reference chains because their grammatical embedding makes them not grammatically prominent. *There* (10) is locative, and chains; *there* (24) is simply an existential element and doesn't.

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THE ENGLISH GERUND-PARTICIPLE IN COGNITIVE GRAMMAR

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The term 'gerund-participle' used in the title of this paper is adopted from Huddleston and Pullum (2002:80), who see no reason to give priority to one or the other of the traditional terms used to refer to the verbal uses of the English *-ing* form illustrated in (1):

(1) a. He was expelled for killing the birds.
b. They are entertaining the Prime Minister.

The meaning of this form is generally defined as 'imperfective' (Hirtle 1975:20–21, Freed 1979:72–73), 'durative' (Kruisinga 1931:259) or 'ongoing' (Dixon 1984:588–89, 1995:185; Hewson & Bubenik 1997:5–6), whence the term 'progressive'. This view of the gerund-participle's meaning has gone virtually unquestioned over the past fifty years of linguistic research on English.

In more recent times, cognitive grammar has brought a new approach to the field, applying the tools of cognitive psychology to the study of human language. The goal of this paper will be to evaluate whether any progress has been achieved by the application of these analytical instruments to the English gerund-participle. This will allow certain more general considerations to be made about the methodology underlying the cognitive grammar approach.

The fundamental concepts used by cognitive grammar to describe the meaning of the gerund-participle are those of 'scanning' and 'scope of predication'. As it applies to temporal entities, scanning refers to the mental processing of an event. Two modes of cognitive processing can be distinguished in this domain. Sequential scanning involves 'following a situation state by state as it evolves through conceived time' (Langacker 1991b:80). This produces a dynamic representation of an event which reflects the successive transformations deriving each state from its predecessor. Summary scanning is a more complex operation and involves building up a complete image of an event by accumulating images of all of the instants actualized at each moment of the event's development (Langacker 1991b:79–80). This is comparable to forming a still photograph through multiple exposures (Langacker 1987:73). Applied to the example of a ball falling to the ground, the diagrams in **Figure 1** (overleaf) represent sequential (part 1) and summary (part 2) scanning.

In the grammatical domain, verbs are claimed to be distinguished from such classes as adjectives, adverbs, prepositions, infinitives and participles 'in virtue of designating a process as opposed to an atemporal relation' (Langacker 1991a:5) A process is characterized as a relationship followed sequentially in its evolution through conceived time, whereas an atemporal relation, in the case of infinitives and participles, involves suspending the

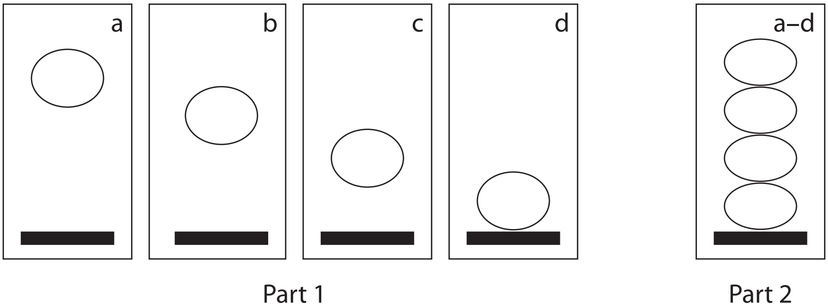

Figure 1. *Sequential (Part 1) and summary (Part 2) scanning of a ball falling to the ground.*

sequential scanning of the verb stem, i.e. summary rather than sequential scanning (Langacker 1991b:82). This allows the *-ing* form to serve as a noun modifier and bars it from being the head of a finite clause (ibid:91).

Several questions arise at this point. The first is whether summary scanning provides an adequate description of the meaning of English non-finite forms. For instance, from the point of view of the event itself denoted by the *-ing* form, the way in which the situation is presented seems clearly sequential in some uses:

(2) The woman strolling down the beach is my mother.
(3) I found my little brother tearing my photo album to pieces in my bedroom.

A second question concerns the connection claimed to exist between summary scanning and the capacity of fulfilling a noun modifier function. If, as claimed by the theory, the bare infinitive involves the suspension of sequential scanning and the attendant conversion of the processual predication of the stem into an atemporal relation, one wonders why this non-finite form cannot modify a noun:

(4) *The person see is Joe.
(5) *The only person be named was Theresa.

Thirdly, the application of summary scanning, as one would expect, is claimed to impose a 'holistic perspective' on the process designated by the verb stem (Langacker 2000:10). This does not square very well with the use of the *-ing* form in the progressive construction, where it always evokes the event as somehow incomplete.

Indeed, Langacker bases his description of what is specific to the semantic content of the *-ing* morpheme on the impression produced by the gerund-participle in the progressive construction, characterizing it as imposing 'a restricted immediate scope of predication comprising an arbitrary sequence of internal states (i.e. the initial and final states are excluded)' (1991b:91–92). Verspoor (1996:437–38) elaborates this in terms of perceptual scope, proposing that the schematic value of the *-ing* form is to symbolize 'an imperfective atemporal relation viewed from an internal perspective… the conceptualizer (speaker/

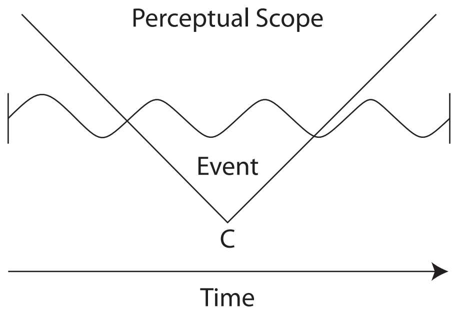

Figure 2. *Imperfective atemporal relation viewed from the conceptualizer's perspective.*

viewer) construes an event as seen from very close-by so that his perceptual field includes an event in progress, but the boundaries of the event… are not within his perceptual scope'. This is diagrammed as in **Figure 2**.

The *-ing* morpheme is thus used to 'imperfectivize the perfective process designated by the verb stem it combines with' (Langacker 2000:226–27), construing it as unbounded within the immediate temporal scope. Hamawand (2002:65) adopts basically the same definition: 'The *ing* participle designates an imperfective simple atemporal relation, which excludes its initial and final states'.

The definition of the *-ing* form's semantic content just described is applied only to the participial uses of the *-ing* (noun-like uses are accounted for by a nominalization process which is discussed below). Verifying the definition against usage reveals, however, that there are a number of uses where it does not correspond to the data. One case is raised by Langacker himself (1991a:210) in relation to the attributive modifier use of the *-ing* form found in (6) and (7):

(6) anyone knowing his whereabouts
(7) people still believing that the earth is flat

Here the verb stem is imperfective (in Langacker's sense of 'stative') and so the role of the *-ing* cannot be that of imperfectivizing a perfective process (i.e. stativizing an action). Langacker proposes therefore that the role of the *-ing* morpheme here is simply to atemporalize the verb stem so that it can be used as a noun modifier. However, since atemporality is a characteristic shared by all non-finite verbal forms, one may ask why the infinitive and the past participle would not do the job just as well as the *-ing* form for this purpose. Moreover, the fact that the *-ing* form is not semantically equivalent to the past participle in noun modifier function shows that there is more to its meaning here than the mere notion of atemporality:

(8) a. a charging battery
b. a charged battery

In addition the definition of the *-ing*'s meaning excludes the initial and final segments of the event. Counterexamples for this claim can be found in appositive function. In this type of construction, one observes not only stative events, such as (9), but also complete actions, as in (10):

(9) Being a good friend of the family, John received an invitation to the party.
(10) Knocking twice, she opened the door and entered the apartment.

To claim in the latter case that the initial and final segments of the knocking are not evoked flies in the face of the message conveyed by this sentence.

When nominal uses of the type illustrated in (11) below are treated, Langacker's cognitive grammar analysis shifts from the word-level to that of the clause:

(11) Zelda's reluctantly signing the contract

Such 'factive nominalizations' are held to apply to a higher-level structure: *reluctantly signing the contract* is characterized as a 'processual expression that has all the ingredients of a finite clause except an explicit subject and a grounding predication (i.e. tense or a modal)' (Langacker 1991a:32). Since this clause-like higher-level structure is processual, it involves sequential scanning and can consequently evoke a perfective event, as in (12):

(12) Sam's washing the windows was a shock to everybody,

where one understands that Sam performed the complete action of washing the windows.

The problem with this is that the participial uses of the *-ing* form are also clause-like, as they also allow adverbial modification, direct objects and perfect constructions:

(13) A man laboriously dragging a heavy object came into view.
(14) Having signed the contract, Zelda could now turn her mind to other matters.

This should mean however that the *-ing* is processual here, which is in direct contradiction with the definition of the *-ing* participle as involving summary rather than sequential scanning. Indeed, we have noted uses such as (2) and (3) where the *-ing* form denotes events in progress which are followed sequentially as they evolve through time.

What can be concluded from these observations? First of all, that the concepts of summary and sequential scanning are tangential to the distinction between finite and non-finite verb forms in English: the existence of non-finite forms which are clearly processual shows that scanning cannot be the basis of the traditional distinction between conjugated and non-conjugated verb forms. Secondly, that Langacker's approach confuses word and clause levels in its analysis of the English *-ing* form: if the *-ing* is the sign of a clause-level nominalization in uses like (11) and (12), why does this ending attach to the verb stem rather than to the higher-level clause-like structure which it is claimed to nominalize? A third conclusion which must be drawn is that the cognitive analysis of the *-ing*'s semantic

content has been unable to go beyond the traditional definition of the gerund-participle as denoting progressive aspectuality. Although this is perhaps the most frequent impression associated with the gerund-participle, there are many cases where it does not apply.

On a deeper level, one might ponder over the reasons why progress has not been achieved on the definition of the semantic content of the English gerund-participle by the application of the analytical principles of cognitive grammar. Notions such as summary vs. sequential scanning and immediate scope, used as explanatory tools by this theory, have been borrowed from cognitive psychology, where they were developed from research on human perception. Their applicability to human language cannot, however, be taken for granted. A properly linguistic methodology should involve a careful observation of the linguistic items which constitute one's object of study. This means starting with the linguistic sign as the basis for defining linguistic categories, not with notions developed in other fields which make no reference to this sign. Another example of the tendency of the cognitive approach to start with notional categories defined independently of the linguistic sign is Janda's treatment of aspect in Russian (Janda 2004), in which the opposition between discrete solid objects and fluid substances is taken as the source domain for the metaphor that motivates the grammatical categories of perfective vs imperfective aspect. Other authors, noting the wild diversity of prefixes producing aspectual effects on the level of the message expressed in the sentence, have observed that perfectivization by prefixation is 'a basically lexical process' (Brecht 1985:17). Indeed it would be surprising that such a heterogeneous collection of signs should all correspond to one homogeneous meaning. In this sense, one might tax the cognitive grammar approach with having substituted generative grammar's universal logical categories by other categories which are just as universal, even though they are psychological in nature. The shift from the logical to the psychological is a positive step. The utilization of universal categories as the starting-point of the analysis, with the reduction of meaning to perception or perception-like phenomena, is not necessarily a guarantee of progress in the scientific understanding of human language.

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THE VERB *KEEP* IN LEXICAL SEMANTICS: A COMPARATIVE STUDY

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In his influential book *Concepts: Where cognitive science went wrong*, Fodor argues for an atomistic theory of word meanings according to which they lack internal structure. For example, for Fodor the verb *keep* everywhere expresses the concept KEEP, and specifically does not express some putative definition such as CAUSE A STATE THAT ENDURES OVER TIME. Though earlier work of his provided arguments from a psycholinguistic perspective against a meaning component view of the representation of word meaning (see especially Fodor et al. 1980), throughout Fodor 1998 the arguments are very much of a philosophical bent. Most notably he argues against Jackendoff's account of the following four semantic field/sentence pairs:

(1) Spatial location and motion: Harry kept the bird in the cage.
(2) Possession: Susan kept the money.
(3) Ascription of properties: Sam kept the crowd happy.
(4) Scheduling of activities: Let's keep the trip on Saturday.

Jackendoff suggests that while the occurrences of *keep* in these sentences 'all denote the causation of a state that endures over a period of time', the different semantic field of each occurrence of the verb, as noted, 'has its own inferential patterns' that determine the appropriate interpretation. Fodor's argument against Jackendoff's account here turns on the idea that the concept CAUSE itself can have different interpretations in different contexts; therefore, according to Fodor, it cannot be used to render one consistent concept across different semantic fields. We won't get into the details of Fodor's argument here. Suffice it to say that Fodor sees no solution to the philosophical quandary that 'definitional theories' of concepts find themselves in other than the solution offered by his own atomistic theory of word meanings.

Nevertheless, there is a substantial amount of work in lexical semantics that takes or implies some version of a meaning component or decompositional view of word meaning. And when we take a look at some of that work it is not difficult to find accounts of the semantic characteristics of the verb *keep*. In particular, apart from Jackendoff's account of *keep*, this paper examines what we can learn about it from the work of Beth Levin and Anna Wierzbicka, both of whom assume meaning components. The general point of the present study is that work in lexical semantics is revealing of the semantics of *keep* in ways that are precluded from a theory like the one suggested by Fodor, which regards all words as primitive concepts.

We begin with Levin 1993, which provides a quite extensive categorization of English verbs. We use Levin's analysis to consider the following data involving *keep*:

Middle Construction	Conative Construction	Body-part Ascension
a. The bread cuts easily. b. Crystal vases break easily. c. *Cats touch easily. d. *Door frames hit easily.	a. Margaret cut at the bread. b. *Janet broke at the vase. c. *Terry touched at the cat. d. Carla hit at the door.	a. Margaret cut Bill on the arm. b. *Janet broke Bill on the finger. c. Terry touched Bill on the shoulder. d. Carla hit Bill on the back.

Table 1. *Examples of Levin's three alternations used to classify English verbs.*

	cut	*break*	*touch*	*hit*
Conative	Yes	No	No	Yes
Body-Part Possessor Ascension	Yes	No	Yes	Yes
Middle	Yes	Yes	No	No

Table 2. *Four classes of verbs (Levin 1993:7).*

(5) John kept the book.
(6) John kept the book on the shelf.
(7) John kept talking.
(8) John kept Mary from doing her homework.
(9) John has kept well over the years.
(10) John kept his promise.
(11) *John kept at the vase. (compare 'John shot at the vase')
(12) *John kept Bill on the shoulder. (compare 'John touched Bill on the shoulder')

Levin uses, among others, the three kinds of alternations in **Table 1** to classify English verbs. The four verbs in **Table 1** can be classified for the three types of alternations as shown in **Table 2**. Levin found that these four verbs can be used to classify a substantial number of verbs into four corresponding sets and that their syntactic behavior seems to correspond to the presence in their semantic representations of certain meaning components. She concludes as follows (1993:10):

> *[T]ouch* is a pure verb of contact, *hit* is a verb of contact by motion, *cut* is a verb of causing a change of state by moving something into contact with the entity that changes state, and *break* is a pure verb of change of state.

Using just these three sentence construction alternations (conative, body-part ascension, and middle construction) from among the many used by Levin throughout her book, we see that sentence (9) shows that *keep* is positive for the so- called middle construction alternation, as in *These shirts wash well*. But the strangeness of (11) and (12) illustrates that *keep* is negative for the conative and body-part ascension alternations. This means that, considering just these four classes of verbs, *keep* classifies best with *break*—which is Yes for middle, but No for both the conative and body-part ascension alternations—as 'a pure verb of

change of state,' which suggests that *keep*, like *break*, must have at least the elements CAUSE and CHANGE in its meaning.[1] What is interesting and helpful about this analysis is that the presence of these meaning components helps to explain the syntactic behavior, not only of the verb *keep*, but more generally of several large sets of verbs. That is, without the meaning components we lose the ability to make the kind of explanatory generalizations that allow Levin to classify English verbs in a perspicuous manner.

Next, we turn to what Wierzbicka (1988) has to tell us about the verb *keep*. Wierzbicka (1988) is intended to reinforce her overall guiding principle that syntax is naturally part of semantics and that syntactic or grammatical constructions convey meaning. In addition, according to Wierzbicka, it is the overall sentence, considering both its syntactic structure and the words in it, that interact to determine meaning. In fact, Wierzbicka (1988:8) states that 'the notion of the meaning of a word in isolation is in any case a fiction.' Nevertheless, her analysis of sentences with *keep* attributes certain aspects of meaning to it, albeit with a correspondingly careful attention to the meanings of the grammatical constructions in which it occurs.

Wierzbicka focuses on *keep* as an aspectual verb, a verb whose meaning is closely related to time. Levin (1993:275) also classifies *keep* as an aspectual verb, within a smaller group of *begin* verbs, some of which (presumably like *keep*) 'allow transitive causative uses.' Wierzbicka examines the relationship between the type of complements, particularly TO and ING complements, that *keep* takes and the time-related features of its meaning. She points out the following patterns between pairs of near-synonymous aspectual verbs:

(13) a. John ceased peeling the potatoes/to peel the potatoes.
b. John stopped (quit) peeling the potatoes/*to peel the potatoes.
(14) a. Mary continued worrying/to worry.
b. Mary kept worrying/*to worry.

Regarding the pair of sentences in (13), Wierzbicka (1988:80) claims that '*stop* refers to a sudden change from action to non-action', while '*cease* is quite compatible with gradual change' (1988:80). She cites the following evidence in support of these claims:

(15) The noise stopped/?ceased as suddenly as it had started.
(16) Gradually, imperceptibly, the tremor/rain ceased/?stopped.
(17) Stop/*cease (it) at once!

Moreover, according to Wierzbica (1988:80), 'gradual changes leave more room for expectations than sudden, abrupt ones', and 'sudden changes are likely to be an unpredictable act of somebody's will'. While her comments about *stop* and *cease* might be a bit suspect here ('Cease fire!' is usually taken as requiring a 'sudden change from action to non-action'),[2] her comments relevant to the meaning of *keep* seem to be on firmer ground. With respect to *continue* and *keep*, she focuses more on the contrast between expectations, which is clarified further by the following pair of sentences:

(18) Mary kept painting her car.
(19) Mary continued to paint her car

According to Wierzbicka, (18) with *keep* 'suggests that Mary painted her car many times,' and it further suggests 'arbitrary and unpredictable behaviour on Mary's part'. Sentence (19) with *continue*, on the other hand, suggests a process that 'could be expected to last for a certain time (until the whole car was painted)' (1988:82). In general then, while both *keep* and *continue* seem to imply a duration of time, there is a certain sense of arbitrariness, unpredictability, and lack of expectation surrounding the meaning of sentences with *keep*, which is absent from sentences with *continue*.

Now TO complements have the following component in their meanings: 'one could think that it would happen after that' (Wierzbicka 1988:78). In other words, TO complements imply expectation, which *keep* does not allow. This is why TO complements do not occur with *keep*, as we can see from (14)b. On the other hand gerundive ING complements, which do occur with *keep*, generally refer to a stretch of time. Verbs like *keep* which suggest a 'constant possibility of change' are compatible with the notion of a stretch of time. This explains why *keep* can occur with ING complements, and also why *keep* does not occur with 'purely stative complements' (Wierzbicka 1988:87):

(20) ??She kept liking him/expecting him to call.

In other words, stative verbs by their very nature do not allow for the 'constant possibility of change', and so are not compatible with *keep*.

Wierzbicka also discusses constructions like the following:

(21) He stopped them talking.
(22) He kept us waiting.

These constructions have the form 'NP + aspectual verb + NP + ING' and carry a causative meaning. These structures imply 'that the time of the action is determined by the causer's whim', which is compatible with the unpredictability in the meanings of both *stop* and *keep* (Wierzbicka 1988:95).

Even if we factor out instances where we might question the intuitions of Wierzbicka or Levin about specific sentences, or where we might find putative counterexamples, several ideas seem to emerge about the meaning of *keep*. First, it seems that we can deduce from Wierzbicka 1988 that *keep*, at least in certain constructions, has in its meaning the notion of a duration of time together with the concept of the possibility of change. This supplements what we already know about the meaning of *keep* from Jackendoff and Levin. While the three approaches are different and function under different assumptions about the relationship between syntax and semantics, they all seem to imply very similar conclusions about the components of the meaning of the verb *keep*. Moreover, their willingness to see word meanings as complex seems crucial to the important insights and generalizations

this work has uncovered, not only about the verb *keep*, but also about similar and contrasting classes of verbs.

Finally, let us return to Jackendoff's response to Fodor's criticism. One major aspect of this response is implied in the following statement: 'Fodor believes that lexical concepts have no parts because he assumes an extremely limited view of what the parts could be and how they could combine' (Jackendoff 2003:334). In fact, Fodor restricts himself to phrasal definitions like the ones that can be found in a dictionary. In contrast, Jackendoff cites an analogy with the phonological structures of words:

> The phonology of a word is certainly not monadic and innate; it is built from known parts. At the first layer of decomposition, we find a repertoire of language-specific syllables; at the second, a repertoire of partly language-specific speech sounds; at the third, a universal repertoire of distinctive features. What we take to be innate is the repertoire of distinctive features, plus general principles for building them into language-specific repertoires of sounds, syllables, and words. (ibid:335)

Furthermore, Jackendoff points out that at the level of distinctive features, not only can't they be words on their own; they can't even be sounds on their own. He suggests that there is no reason to think that the meanings of words, like their sounds, might not be similarly fine grained and so beyond the reach of Fodor's very limited notion of phrasal definitions.

But from my own perspective, Jackendoff's response to Fodor suggests another more general issue. It seems that part of the reason why Fodor makes the argument that he does, trading on the absence of a 'univocal' meaning for words like *keep* or *cause*, is that he doesn't recognize a level for the formal representation of the meanings of lexical items beyond the words themselves. According to Fodor, CAUSE A STATE THAT ENDURES OVER TIME cannot encapsulate what is invariant in the meaning of *keep* across different semantic fields because the very words in the definition behave just like *keep* in appearing to have slightly different meanings in different contexts. Thus, Fodor (1998:51) suggests that we 'consider the question whether, for example, "CAUSE" is univocal in, say, "CAUSE THE MONEY TO BE IN SUSAN'S POCKET" and "CAUSE THE CROWD TO BE HAPPY"'. Clearly, if we are only allowed to construct a theory in which word meanings are rendered by phrasal definitions, we will never find truly 'univocal' meanings since words, by their very nature as signs in the complex semiotic system of a natural language, are, so to speak, almost always multi-vocal. However, if 'CAUSE' in Jackendoff's definition for *keep* is part of a formal theory of the meanings of words, then the question of whether it is 'univocal' doesn't arise. In the formal representations of the meanings of words in such a meaning component theory, whenever 'CAUSE' occurs it always stands for the 'CAUSE' that is part of the formal system, just as '+VOICE' always represents the same feature in a feature matrix whenever it occurs. But even if we consider phonemes rather than distinctive features as more analogous to semantic components, we can see clearly the weakness in Fodor's argument. After all /p/ is no more or less 'univocal' than CAUSE, but most phonologists would accept it as a part of the underlying representations of the English words *pill* and *spill*, the part which is represented on the phonetic level—the level where representations truly get vocalized and on which it

makes sense, perhaps, to insist that representations be univocal—by the phones [p^h] and [p] respectively. Of course, in general the purpose of the more abstract representations is to capture important generalizations. For example, the VOICE feature with its binary values allows us to explain part of the alternations in the pronunciations of the regular past tense endings on many regular verbs and the plural endings on many nouns in English. In a similar way, with respect to meaning components, the question is only this: can the abstract representations of a meaning component theory, like Jackendoff's proposed representation of the meaning of *keep*, provide revealing accounts of the meanings of words that can help to explain various meaning-related phenomena of the sentences in which those words occur, including various kinds of meaning-driven alternations? The work of Levin, Wierzbicka, and Jackendoff seems to suggest that the answer to this question is strongly in the affirmative.

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1 Ravin (1990:40) suggests that 'there are verbs like stay or remain which explicitly include a non-change in their meaning', so that the meaning of *keep* might contain something like the representation (A/(CHANGE)), where 'A/' is Katz's antonomy operator.

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CLAUSE COMBINING IN ENGLISH NARRATIVE DISCOURSE

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The clause is the basic grammatical unit of communication, in which NPs and VPs are combined to form propositions, whereas the words and phrases can only point to entities and concepts.[1] When clauses are combined, we can express the relationships that are possible at the interpropositional level, such as temporal succession or overlap, contrast or counter-expectation, and cause-effect. In both written and oral texts, we often use sentences that consist of more than a single clause. We express ourselves by putting together temporally and logically related propositions. There may be several modes of combination available in languages, not just coordination and subordination (Haiman & Thompson 1988; Bybee & Noonan 2002).

This paper presents the following clause combining devices as on a continuum[2] and describes how they function in discourse, primarily using a short story from English. It thus focuses on the surface marking in combining clauses, not on the semantic and rhetorical relations between propositions, as in rhetorical structure theory (Matthiessen & Thompson 1988) or combinations of predications (Longacre 1996).

1. Juxtaposition (clauses joined intonationally or by non-final punctuation but without conjunctions)
2. Coordination (conjoined by conjunctions like *and, but, or, so*)
3. Chaining (functionally coordinate but syntactically dependent for inflections like tense)
4. Adverbial clauses (with subordinating conjunctions like *when, if, before*)
5. Nonrestrictive relative clauses and some complement clauses

Juxtaposition (e.g. *He's courageous; he's not fearful*) may group with coordination; it lacks an overt conjunction but has a comma or semicolon in writing, while in speech a non-final intonation contour after the first clause. English uses several other clause combining devices in grammar within the sentence: coordinate conjunctions (*and, but, or, so*), subordinate conjunctions (*as, because, when*), and detached participial clauses (with the verb in *-ing* forms). From a cross-linguistic perspective, participial clauses are similar to medial clauses in chaining languages, in that their verbs are not fully inflected for tense or mood. They are syntactically dependent, but functionally they may be clauses of almost equal rank with the final or main clause.

Adverbial clauses, as Matthiessen and Thompson (1988) argue, do not represent an embedding of an adverbial adjunct within a clause but are clause combining. Prototypical complement and relative clauses, however, represent an embedding relationship between

clauses, the former being a clause functioning as an argument of another clause, and the latter a clause within an NP. But there are exceptional cases, such as nonrestrictive relative clauses and complement clauses of parenthetical epistemic expressions like *I think*, that are not considered embedding (Thompson 2002).

This paper asks the question: why are two propositions sometimes presented as two separate sentences, or as one coordinate sentence with two main clauses, or as a subordinate clause plus the main clause, or as one clause embedded in a complex clause structure? It seeks to answer the question from discourse context; i.e. it shows how discourse conditioning explains selective means of clause combining in the story. Certain sections of discourse may display different patterns of clause combining. Main clauses generally correlate with foreground information that is nuclear to the structure of the text, while adverbial and embedded clauses correlate with background information (Labov 1972, Tomlin 1987). However, an adverbial clause may report foreground information and create a special effect.[3]

After a brief presentation in Section 1 of the discourse structure of an English text, Section 2 presents an analysis of the paragraph and sentence structures to show the distribution of clause combining devices across discourse-level units, such as the stage and episodes. Section 3 describes the discourse functions associated with specific devices.

1. DISCOURSE STRUCTURE OF A SAMPLE TEXT FROM ENGLISH. We will examine a short story of thirty-two sentences from English to see the clause linking devices used, along with their frequencies and functions in the overall discourse.[4] The story is printed in eight orthographic paragraphs in the book. The macrostructure of this story is described as: Little Hans received an apple from a girl, crept into the cathedral, and (in an agony of fear) placed on the offering plate the apple, which changed into gold.

The first two orthographic paragraphs function together as the stage of the story, presenting the great cathedral and the central participant Hans. The next two paragraphs join together as the prepeak episode, reporting the notional structure of the inciting incident of a little girl giving an apple to Hans and his going into the warm cathedral. The notional climax of tension occurs at the peak episode, where poor Hans has nothing to give at collection time. Peak is defined as an episode-like unit that has unusual surface structure features in the flow of discourse and often corresponds to a climax of tension or denouement in the notional structure (Longacre 1996). Denouement, the untying of the knot of tension, follows in the postpeak episode. Here Hans offers the only thing he has, the apple. The story ends with the closure, where the apple turns to shining gold on the offering plate, which makes Hans joyous. We propose the discourse structure of the text as given in **Table 1**, with discourse-level slots in surface structure (SS) and notional structure (NS) with summary contents.

2. DISTRIBUTION OF CLAUSE LINKAGE IN PARAGRAPH AND SENTENCE STRUCTURES. The paragraph-internal structure of the discourse-level slots of the story, e.g. the stage and prepeak episode, are analyzed following the methodology in Longacre (1996). In the selected text, different slots display differing patterns.[5]

SS Slot	NS Slot	Sentences	Content
Stage	Exposition	s1–6	Coldness and Hans outside cathedral
Prepeak Ep	Inciting Incident	s7–13	Girl giving apple to Hans
Peak Ep	Climax	s14–25	Hans agonizing at collection time
Postpeak Ep	Denouement	s26–29	Apple given and taken to altar
Closure	Conclusion	s30–32	Apple turning into gold

Table 1. *Discourse structure of the text.*

2.1. THE STAGE. The first three sentences are each a thesis in a coordinate paragraph describing the bleak setting of the city, the chimneys and streets, and the great cathedral. It is like zooming in the camera lens from a larger to a smaller setting. The cathedral is introduced in s3 with marked grammatical features. After the sentence-initial adverbial phrase, a preposed participial clause (PrPtcCl, shown in angle brackets with boldfaced *-ing*) occurs before the main clause in VS order, similar to a presentational construction. Then two participial clauses follow, with explicit subjects referring to parts of the cathedral, *its stones* and *its windows*. The first one describing the stones is viewed as a participial clause as well, with the copula *being* omitted before *dim*. The copula in English, being semantically bleached, is frequently omitted when it is not the main verb. This can be seen in the three preposed participial clauses in s6 shown in (1) as well, where *being* does not appear in any of the clauses.

(1) **Stage: Contrast ¶**
Setting: Coordinate ¶
Thesis 1: s1 *The winter afternoon was dark and grey over old Strasbourg.*
Thesis 2: s2 *Little flurries of snow came whirling down between the chimneys* ***and*** *a biting wind blew in the narrow streets.*
Thesis 3: s3 *Above the roofs, <ris**ing** high into the clouds>, stood the great cathedral, <its stones dim in the gathering gloom>, <its windows catch**ing** the lights within>.*
Contrast: s4 *Fine people were hurrying up the broad steps – ladies with furs, gentlemen in splendid attire, <many of them com**ing** in their carriages>.*
Thesis: Comment ¶
Thesis: s5 <u>*Little Hans watched them.*</u>
Comment: s6 *<Perished with cold>, <ragged>, <an unwanted bit of humanity>, he snuggled between two buttresses – a retreat from the wind –* ***and*** *wished he dare go into the cathedral [where all was warm and bright], and [where (as he could dimly hear) the organ was pealing loudly].*

The zooming in of the camera continues with s4 and s5, moving from the people going to the cathedral to Hans watching them. Then s6 gives a physical description of the boy (in three participial clauses and the first main clause) along with his thoughts in the second main clause in a coordinate structure. The complement clause of the second clause has two nonrestrictive relative clauses (shown in brackets), which provide further descriptions of the cathedral as he

perceives it. The well-dressed people going to service in S4 is contrasted with ragged Hans watching them in S5–6. There is a double contrast here, both in their attire and their actions. Those clauses describing Hans are nuclear in the contrast and thus signal the thesis, which consists of a comment paragraph, where S6 is the comment on the thesis in S5. The thesis is underlined to show its nuclearity in the stage, but it is not on the eventline. With the verb *watch* it reports a durative activity, setting the stage for upcoming events.

Clause linkage in the stage is summarized in (2) within the overall paragraph structure. (Those for other slots are not shown due to the space limitation, but the overall results are in **Table 2**.) The first sentence is viewed as a single clause (i.e. simple sentence) with an adjective phrase *dark and gray*. The thesis is a short sentence of a single clause: *Little Hans watched them*. In both S2 and S6, *and* conjoins two clauses, but S6 is much more complex, with three participial clauses with the same subject as that of the main clause, and then ending with two long nonrestrictive relative clauses.

(2) Setting: Coordinate ¶
  Thesis 1: S1 Cl (with an adjective phrase)
  Thesis 2: S2 CoorCl (2 clauses with *and*)
  Thesis 3: S3 Cl with PrPtcCl, and 2 PoPtcCl
 Contrast: S4 Cl with PoPtcCl
 Thesis: Comment ¶
  Thesis: S5 Cl (with only 4 words)
  Comment: S6 CoorCl (2 clauses with *and*), 3 PrPtcCl (*being* omitted), 2 NRRC

2.2. THE PREPEAK. The prepeak episode, (3), is packed with action. It is filled by a sequence paragraph with four sequential theses (ST). S7 and S8 group together as the lead-in actions of the girl and her speech. They form an unresolved simple dialogue paragraph, which functions as the first ST. After the next two STs with a sentence each, S11–13 form a reason paragraph functioning as ST4. S11 is the setting when Hans goes to the door, and S12 is the reason for his action in S13.

(3) **Prepeak Ep: Sequence ¶**
 ST1: (Unresolved) Simple Dialogue ¶
  Lead-in: S7 *Suddenly a little girl left her mother {**as** she came up the steps}, ran towards him (all loveliness as she smiled)* ***and*** *thrust a big rosy apple into his hands*.
  Initiating Utterance (Remark): S8 *"That's for you, little boy," she said.*
 ST2: S9 *Then she and her mother went in at the great west door,* ***and*** *Hans stared at the apple.*
 ST3: S10 *He thought at first he would eat it there and then,* ***but*** *he wanted to keep it for a time,* ***so*** *he held it in his hands,* ***and*** *went timidly to the door of the cathedral.*
 ST4: Reason ¶
  Setting: S11 *Most of the folk were in,* ***and*** *the service had begun.*
  Reason: S12 *No one turned him away.*
  Thesis: S13 *He plucked up courage* ***and*** *crept inside,* <*slink**ing** into a pew at the back*>.

Both S7 and S10 join closely-related actions in sequence (by the girl and by Hans), creating long sentences with coordinating conjunctions. The whole episode consists of sentences combining two or more clauses, except S12. Five sentences (underlined) out of seven in the episode report actions on the mainline. The setting information in S11, with two main clauses in coordination, is off the mainline. It is so indicated by the copula verb (*were*) and the pluperfect form of the verb (*had begun*) for a flashback, i.e. the event occurred prior to the narrative timeline but with continuing relevance. The participial clause in S13 (*slink**ing** into a pew at the back*) denotes a mainline action subsequent to 'creeping inside' and shows a tighter integration to the preceding clause than there would have been with a coordinate structure.

2.3. THE PEAK. The peak episode, (4), is filled by a contrast paragraph, contrasting Hans and the people at the offering time. The sentences about Hans are nuclear and occur cyclically as the thesis and the thesis' with the contrast in the middle in one sentence. S20 is of a juxtaposition type, which is like a reverse order structure with a complement clause ('He could hear (it) that others were giving money'), but the content of his cognition (*Others were giving money*) occurs first, giving the exigency of the situation.

(4) **Peak Ep: (Cyclic) Contrast ¶**
Setting: Amplification ¶
Thesis: S14 *Only vaguely could he understand the service,* ***but*** *it was wonderful.*
Amplification: S15 *He loved the singing, the colour, the warmth.*
Thesis: Circumstantial ¶
Circumstance: Result ¶
Thesis: Summary ¶
Pre-summary: S16 *Then something terrible happened.*
Thesis: S17 *{**Before** he realized it}, dignified men coming down the aisles were taking up the collection,* ***and*** *Hans – poor Hans – had nothing to give.*
Result: S18 *He would have run out had he not been too frightened to move.*
Thesis: S19 <u>*What was he to do?*</u>
Contrast: S20 *Others were giving money – he could hear it.*
Thesis': Reason ¶
Thesis: Paraphrase ¶
Thesis: S21 <u>*He had nothing . . . nothing to give God except for his apple*</u>*,* ***and*** <u>*he could not give that*</u>*.*
Paraphrase: S22 *He dare not.*
Reason: Coordinate ¶
Thesis 1: S23 *What would all the people say?*
Thesis 2: S24 *What would the man in the fine clothes say – the one standing on the steps amid all the bright candles at the far end?*
Thesis 3: S25 *And wouldn't God be angry, too?*

The thesis in S16–19, along with the setting in S14–15, more or less preserves the longish sentence pattern in the previous episode. But S19 (*What was he to do*?), which is the thesis

in that section, is short and is the first rhetorical question. Then after the contrast, a similar train of thought follows, starting with a longer sentence in S21. Then, there is an extremely short sentence (*He dare not*), followed by three more single-clause rhetorical questions in parallel structure. The gradual progression to short, choppy sentences reflects the climax of tension at the moment. The peak episode is marked to show turbulence in the flow of the narrative by the change in style from clause combining to single-clause sentences. Other peak-marking features are the occurrence of four (rhetorical) questions, unusual in the stream of narration but enabling us to peek into the mind of Hans, a cluster of negatives (expressing frustration), and an extensive use of modal forms like *would* and *could*. Two sentences (S19 and S21) are marked as nuclear by the label thesis, but there is no eventline material at peak. There is no progression of events in temporal sequence, but only a succession of sentences describing Hans in his agonizing moment.

2.4. THE POSTPEAK. In the postpeak episode, (5), the sentences are longer, going back to the pattern found prior to the peak episode. The beginning sentence S26, however, still has peak-like features as a transitional sentence. But it is best considered to mark the onset of a new episode on the basis of some clues, e.g. the overt reference to Hans by name—thus going back to the objective perspective, a subsequent reference to him by a pronoun, and the shift to action from reflection. The main clause continues the reflective mode used earlier, but then a remarkable postposed adverbial clause with *when* reports perhaps the single most prominent action of the story. Hans puts the apple on the offering plate! This example does not conform to the general observation that adverbial clauses encode background information and main clauses encode foreground information, which has been noted from Labov (1972) to Tomlin (1985, 1987) and Givón (1987). It illustrates that postposed clauses sometimes have an unusual function of dramatically marking unexpected, surprising foreground information. They also preserve the iconic sequence of events and integrate tightly with the preceding main clause.

(5) **Postpeak Ep: Sequence ¶**
  ST1: S26 *It seemed to Hans as if all eyes were fixed on him {<u>when, in an agony of fear, he timidly placed the red apple on the plate</u>}.*
  ST2: Paraphrase ¶
    Paraphrase: S27 *He held his breath, **but** no one spoke, **and** the man who took the apple did not frown.*
    Thesis: S28 *<u>He allowed it to remain on the plate with the silver coins</u>.*
  ST3: S29 *Slowly <u>he walked along the aisle and up the steps to the choir</u>, [<u>where he handed the plate to the priest</u>, [<u>who blessed the gifts and then reverently placed them on the altar</u>]].*

The sequence paragraph functioning as the postpeak episode consists of three ST's, but ST2 does not really report an event, rather it states what happens between ST1 and ST3. The last clause in S27 is roughly a paraphrase of S28, in a sort of 'not – but' structure: 'the man did not frown but allowed it to remain'. Why are they not in the same sentence, as we

	S	Cl	Cl/S	SgCl S	CoorCl (+2 JuxtCl)	SgCl main	PtcCl	AdvCl	NRRC
Stage	6	18	**3.0**	2	5 (in 2 S)	2	4Pr, 3Po	—	2
Prepeak	7	19	**2.7**	1	16 (in 6)	—	1Po	1Po	—
Peak	12	18	**1.5**	7	10 (in 5)	—	—	1Pr	—
Postpeak	4	9	**2.25**	1	5 (in 2)	—	—	1Po	2
Closure	3	4	**1.3**	2	—	1	—	1Pr	—
Total n	32	68		13	36 (in 15)	3	8	4	4
in %		100		19	53	4	12	6	6

Table 2. *Distribution of clause combining devices in Hans.*

commonly find? The first part—the 'not' part—is summarily handled in the three-clause sentence in coordination (S27) as a series of happenings (or rather, non-happenings) after Hans puts the apple on the plate. The particular usher's non-action (not frowning) is elaborated in S28, linking it to S29, where he slowly walks to the priest. S29 includes nonrestrictive relative clauses reporting events subsequent to the one in the main clause. They report script-predictable information as to what happens at the offering time at service. Thus they denote events that are routine and less salient than they would have been in a coordinate structure. The events in S29, due to its grammatical subordination of relative clauses, are bundled together in a highly integrated manner.

The sentences in the postpeak episode are generally long, but only one is a coordinate structure with *but* and *and*. S28 has a complex structure with an embedded complement clause, and the other two combine clauses in a more integrated way, with a postposed adverbial clause and nonrestrictive relative clauses.

2.5. THE CLOSURE. Finally, the closure, (6), is filled by a result paragraph: the transformation of the apple into gold is the thesis, and the joy of Hans is the result of that transformation.

(6) **Closure: Result ¶**
Thesis: Amplification ¶
Thesis: S30 *And behold, {**as** little Hans watched}, <u>the apple changed</u>.*
Amplification: S31 *<u>It became shining gold</u> – the most precious of all gifts, and well-pleasing in the sight of God.*
Result: S32 *His joy was boundless.*

Two sentences in this section are single-clause structures, and only the first one has another clause, the *as*-clause, to combine with a simple intransitive clause. After the postpeak episode with back to longer sentences, this section has sentences that are shorter and simpler.

2.6. THE DISTRIBUTION OF CLAUSE COMBINING DEVICES. The distribution of clause combining devices is given in **Table 2**. Note that the peak episode has a low ratio of clauses

per sentence (Cl/S), 1.5, with seven sentences consisting of a single clause (SgCl S) each. The closure, with only three short sentences, has a Cl/S ratio of 1.3.[6]

The units of discourse may be described on the basis of their unique features of clause combining. Two slots, the prepeak and postpeak, have longer sentences in coordination. Their sentences in sequential theses encode foreground information for events in a sequence paragraph. In the stage and peak, the paragraph is of a contrast type and does not include eventline information. The closure filled by a result paragraph includes the significant event of the apple changing into gold. That event is a happening without any action on the part of a participant.

Stage	(s1–6)	7 participial clauses, 2 sentences (5 coor clauses), 2 NRRC
Prepeak	(s7–13)	6 long sentences (16 coordinated clauses)
Peak	(s14–25)	7 short single-clause sentences
Postpeak	(s26–29)	Back to long sentences, 2 NRRC
Closure	(s30–32)	Shorter sentences with simpler structure

3. DISCOURSE FUNCTIONS OF CLAUSE COMBINING DEVICES. In this section we discuss functions of the five general methods of clause combining. A single-clause sentence also needs to be discussed in contrast to other devices. It is a marked form in narration and functions to draw our focus carefully and deliberately to the information that is significant or emotionally involved, e.g. *Little Hans watched them* (s5), *He dare not* (s22), and a series of rhetorical questions at the climax.

3.1. JUXTAPOSITION. Only one juxtaposed sentence occurs in our text: *Others were giving money – he could hear it* (s20). It permits giving the content of the cognition first. It is as if the narrator does not want to take time to start with the identification of the person perceiving, which would be the usual English order ('He could hear that others were giving money'). It reflects the exigency of the tension point. This type of linkage is often used for paraphrases (*He is courageous; he is not afraid*), but it can also be the result of the omission of a coordinating conjunction. An example from another text, *They were not afraid; they did not want revenge*, could have *and* instead of a semicolon, but then it sounds more prosaic. Some sentence types, such as those expressing proportions, have two clauses juxtaposed, as in *The longer they prayed, the calmer the children became*, from the same text.

3.2. COORDINATION. Coordinated clauses in discourse are the main workhorse of narrative, reporting eventline information in temporal sequence. About half of all the clauses in our text belong to this category. When a series of events occurs in succession in the prepeak episode, 16 out of 19 clauses are of this type. Not all coordinated clauses are in temporal sequence. Two related propositions which are not events may be coupled together with *and* or contrasted with *but* or marked by other specific conjunctions. In s27, three coordinated clauses state what happens—or rather, what does not happen—immediately after Hans puts the apple on the offering plate. The peak episode has three occurrences of *and*, none of which encodes temporal succession. The sentence-medial *and* encodes

counter-expectation in S17 and S21, while S27 employs the usual conjunction *but*. The contrafactual sentence in S18 is also a case of coordination of two clauses.

3.3. PARTICIPIAL CHAINING CLAUSES. This clause type does not occur frequently in English but often are the main workhorse of narrative in chaining languages. They commonly share the same subject as the main clause. When they do not, an explicit subject occurs, as in S3 where the cathedral and *its stones* and *its windows* are in part-whole relationship. This type embellishes the main clause descriptions of the cathedral and Hans in the stage. One other occurrence in S13 reports an action of Hans, *slinking into a pew at the back*. (For further discussions of the functions of clause chaining, see Myhill and Hibiya 1988; Mushin 2005.)

3.4. ADVERBIAL CLAUSES. The functions of adverbial clauses vary depending on their position, preposed or postposed (Thompson 1985, Hwang 1994). There are only four examples in our sample text, too few to allow a generalization, but S26 illustrates the use for dramatic effect. Its main clause continues with Hans' thoughts following the agonizing series of questions (*It seemed to Hans as if all eyes were fixed on him*). It is followed by a remarkable postposed *when*-clause, which is significant foreground information about his action (*when, in an agony of fear, he timidly placed the red apple on the plate*). The normal coding pattern of foreground information in main clause and background information in subordinate clause is not followed here. A skewing from the normal coding is always for some effect; here it reports an unexpected turn of events.[7] The *as*-clause in S7 (*as she came up the steps*) links the girl to Hans, who watches the people going up the steps of the cathedral. The preposed *before*-clause in S17 (*Before he realized it*) adds to the tension Hans is experiencing at that moment. The *as*-clause in S30 (*as little Hans watched*) serves a cohesive function of narrating script-predictable information and also helps mark the boundary for the closure, along with the phrase *And behold*.

Clearly, adverbial clauses have different functions in discourse from other clause types.[8] They may function like participial clauses in a language like English, with a functional distinction between preposed and postposed positions. But, unlike adverbial clauses, participial clauses do not normally carry overt conjunctions to mark the semantic or rhetorical relations between propositions. Since they leave such relations unmarked and open, they involve the hearer/reader more in inferring the appropriate relation. Being iconically closer to the main clause, without an overt subject, conjunction, or verbal inflections, they reflect a closer integration across clauses than do adverbial or coordinated clauses.

3.5. RELATIVE AND COMPLEMENT CLAUSES. Nonrestrictive relative clauses, providing additional information, constitute clause combining in English. The two examples in S6 provide background information about the cathedral. Those in S29 report events temporally sequential to that in the main clause, which is possible in languages with postnominal relativization. Although they report events, they are largely predictable in the context of a church service. Thus they are demoted events, rank-shifted to background and cohesion. Complement clauses that are clause combining mostly occur in conversational data as Thompson (2002) notes. In the case of quotation, both direct and indirect, we consider the

quote formula and the quote as combining two clauses: *'That's for you, little boy', she said* (S8) and *He thought at first he would eat it there and then* (S10). Rather than the quote being embedded as a complement clause, it is best to see them as having two main parts (see Longacre 1996:86–89 for discussion). They reflect a more intimate association between clauses than regular coordination with conjunctions.

4. CONCLUSION. This paper shows how discourse conditioning can explain selective means of clause combining in a story from English. At the peak episode reflecting the climax of tension, sentences are choppy, several with single clauses. The episodes before and after the peak have long sentences with clauses in coordination. The stage contains long sentences as well, but this is due more to the use of participial clauses than to coordinated sentences. The sentences in the closure are shorter and simpler. Stories seem to have unique patterns, especially at different discourse-level units such as the peak, e.g. a shift to long or short sentences, and distinct means of clause combining.

In summary, while single-clause sentences reflect a deliberate focus on the proposition, coordinated sentences bundle closely related propositions together. Participial and adverbial clauses function to mark off subsidiary and cohesive concerns from the main and nuclear propositions. However, such normal coding can be skewed to achieve a dramatic effect of surprise. Skillful placement of participial and adverbial clauses is responsive to the flow of information in discourse, showing a functional distribution between preposed and postposed clauses. Nonrestrictive relative clauses may encode subsequent information, but such grammatical subordination shows a lower status of information as in script predictability.

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1 I am grateful to Les Bruce and Marlin Leaders for their comments on the paper.

2 The expression 'clause linkage' is also used to refer to 'the range of linguistic devices used to connect clauses' (Mushin 2005:1). Other points on the continuum may be posited within a language or cross-linguistically, e.g. merged sentences and serial verbs.

3 Foreground information in narrative reports temporally sequential events, generally coded to have end-points by the preterite, simple past, or narrative tense/aspect. Types of information are viewed to be scalar, rather than being simply binary with foreground and background. See Longacre (1996), Hwang (1990), and Givón (1987) for discussions.

4 The story is taken from *Five Hundred Tales to Tell Again* by H. L. Gee (1955, Roy Publishers, New York, 106–7). See Hwang (1997) for an in-depth analysis of this story at the discourse level.

5 To mark varying clause linking devices, angle brackets are used to mark participial clauses <PtcCl>, braces adverbial clauses {AdvCl}, and brackets nonrestrictive relative clauses [NRRC]. Restrictive relative clauses are neither marked nor counted as they do not combine clauses but represent an embedding. Conjunctions and *–ing* are highlighted in boldface. Other abbreviations used are: Cl for clause, Coor for coordinate(d), Ep for episode, Po for postposed, Pr for preposed. S for sentence, and ST for sequential thesis.

6 This pattern of ratio is not shared by five other texts analyzed. Four texts do not show much variation in the ratio. One text has a reverse ratio, a 4.0 ratio of clauses per sentence at peak and 2.0

or below in other episodes. It displays a shift in sentence length at peak, but to longer sentences. Thus the shift may be to more clause combining or to more single-clause sentences. The fact of the shift, rather than its direction, seems to be important in focussing the reader's attention.

7 Thompson (1987) shows that subordinate clauses may sometimes report an event to accomplish 'a text-creation goal', e.g. an orienting or simultaneity function, but does not note the dramatic effect of postposed clauses.

8 Matthiessen and Thompson (1988) show how enhancing hypotaxis, such as adverbial clauses, is a grammaticalization of a satellite (expressing supplementary goals), which supports a nucleus (central goals) in the rhetorical organization of discourse.

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TOWARDS A SINGLE-MECHANISM ACCOUNT OF FREQUENCY EFFECTS

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USAGE-BASED APPROACHES TO LINGUISTICS[1] are committed to explaining language structure in terms of domain-general abilities and mechanisms influencing language use. A central focus of investigation has been frequency effects. However, relatively little attention has been paid to why frequency has the effects that it does. That is, what are the cognitive mechanisms behind sensitivity to frequency? This is the question addressed in this paper.

1. TOKEN FREQUENCY EFFECTS IN LEXICAL ACCESS AND PRIMING. The greater the token frequency of a lexical item, the faster its activation occurs. For word recognition, see Coltheart *et al*. (1977), Glanzer and Ehrenreich (1979), Norris (1984), Paap *et al*. (1987), Goldinger *et al*. (1989), Monsell (1991), Luce *et al*. (2000), and Plaut and Booth (2000).

The second major frequency effect in word recognition is that the higher the token frequency of either the prime or the target, the smaller the amount of priming observed,[2] cf. Scarborough *et al*. (1977), Forster and Davis (1984), Norris (1984), Stark (1997), Perea and Rosa (2000), and Versace and Nevers (2003) for identity priming; Moder (1992) for prime frequency in morphological priming; Thomsen *et al*. (1996) for prime frequency in semantic priming; Goldinger *et al*. (1989) and Luce *et al*. (2000) for prime frequency in inhibitory phonological priming; Schuberth and Eimas (1977), Neely (1991), and Plaut and Booth (2000) for target frequency in semantic priming; and Perea and Rosa (2000) for target frequency in orthographic priming.

Slow recognition leads to low experienced token frequency since slow processors would not recognize as many tokens of a type present in the environment as fast processors, hence Plaut and Booth's (2000) finding that when lexicon size is controlled children who are slow at word recognition show more priming. Conversely, low token frequency of a word leads to slow recognition of the word.

2. PREVIOUS ACCOUNTS. Within Network Theory, Moder (1992) proposed that high token frequency weakens a word's connections to neighboring words. Priming occurs by the spread of activation from the prime to the target. Since high-frequency words have weak connections, they receive less activation from their neighbors and their neighbors receive less activation from them. This account does not explain why high token frequency also reduces identity priming where the prime and the target are the same word.

Ratcliff and McKoon (1988) proposed that the prime and the target form a compound cue used to access long-term memory. The greater the familiarity of the cue, assessed as a weighted sum of the familiarities of the prime and the target, the faster long-term-memory access can occur. The greater the frequency of the target, the smaller the prime's

contribution to overall familiarity of the cue, hence the amount of priming observed is smaller when the target is very familiar, i.e. has high token frequency. This account predicts that high prime frequency should increase priming, since high-frequency primes would contribute much to the overall familiarity of the cue, while in reality high prime frequency reduces the magnitude of priming observed.

Plaut and Booth (2000) propose a distributed connectionist model as a way to account for frequency effects. In this model, the prime and the target are overlapping patterns of activation (which can be understood as ordered sets of 1's and 0's) superimposed on the same set of nodes. The more similar the prime and the target are, the more values they will have in common, hence the transition from the prime to the target will be less costly for the network when the prime and the target are similar: fewer changes to node activation values have to be made. Nodes have sigmoid activation functions, hence more input activation is required to change a node's activation level by a fixed amount in the direction of a value (1 or 0) when the node's resting activation level is already close to that value. Hence, activation of a high-frequency node value during prime presentation will not improve the node's ability to take on that value as much as when the value is mid-frequency. This account does not explain why prime frequency and target frequency influence the amount of priming. According to the account, it is only the frequency of the node values that the prime and the target share that should matter, because the prime and the target do not have an independent existence. The importance of whole-unit frequency in priming is shown by priming asymmetries. For a given pair of stimuli, less priming is observed when the high frequency member of the pair is the prime than when it is the target in semantic (Koriat 1981, Chwilla *et al.* 1998), visual (Rueckl 2003), morphological (Schriefers *et al.* 1992, Feldman 2003), acoustic/phonetic (Goldinger *et al.* 1989) and phonological (Radeau *et al.* 1995) priming.

3. RELEVANT FEATURES OF THE LOCAL ACTIVATION SPREAD THEORY (LAST).

3.1. ARCHITECTURE. LAST proposes that memory is a localist associative network where every unit type—a word, a morph, a phone, a construction, a non-verbal stimulus—corresponds to a TYPE NODE, and every presentation of a type forms a TOKEN NODE (as in the weakly abstractionist approach of Bowers 2000).

In LAST, all types are connected to each other, although these connections vary widely in their strength, while a token is linked to only one type. Evidence for full connectivity between types comes from Ratcliff and McKoon (1981), who found that degree of semantic relatedness between the prime and the target influences the magnitude of the priming effect but not how soon after prime presentation the effect can be observed; thus, closely related words and less strongly related ones appear to be equally close to each other. If this were not the case, activation spreading from the prime would take longer to reach distantly related targets than closely related ones. Therefore, more time would need to pass after prime presentation for the effect of the prime's presentation to be observed with distantly related targets than with closely related targets. Since no differences are found, activation must reach distantly related and closely related targets simultaneously.

The architecture is presented in **Figure 1**.

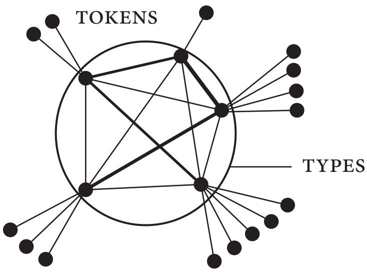

Figure 1. *Architecture of memory according to LAST.*[3]

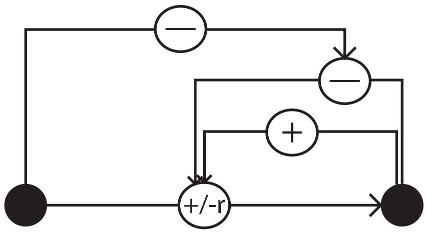

Figure 2. *Link structure in LAST.*[4]

3.2. LINK STRUCTURE. In LAST, a LINK is a unidirectional channel of activation flow in that it only transmits activation from the HEAD of the link to its TAIL. In **Figure 2** a link is represented as an arrow pointing in the direction of activation flow, that is, from the head of a link to its tail. Each CONNECTION in the network consists of two links such that the head of one link is the tail of the other and vice versa. Each link has a PROPAGATION FILTER (PF). Because the two links in a connection have different propagation filters, a connection is represented by two arrows, rather than a single bi-directional one. The resting activation value (r-value) of a link's PF is directly proportional to how much activation is allocated to the link by its head. The PF, however, is not affected by activation spreading through the link it is located on (PF's were first introduced by Sumida and Dyer 1992 and elaborated on in Sumida 1997). If activation flowing through a link increased the PF's r-value, the link would strengthen whenever its head is activated, wrongly predicting that high token frequency words are better linked to their neighbors and therefore are better able to activate or prime them, against findings that high token frequency actually corresponds to reduced priming (see next section).

On the other hand, a link should strengthen whenever its head and tail are activated simultaneously (co-activated) to allow associative learning to occur. This would imply that the PF's r-value is raised whenever the head and the tail of the link are co-activated and hence that the PF of a link is a tail on a subsidiary link (LINKTRON) headed by either the head or the tail of the link the PF mediates. The influence of this linktron must, however, be counteracted whenever the head or the tail is activated in isolation. The link structure

shown in **Figure 2** is the simplest one consistent with the evidence thus far (see Kapatsinski 2005 for relevant discussion).

3.3. DYNAMICS OF ACTIVATION SPREAD. LAST, like many other theories of word recognition (e.g. Morton 1969), proposes that each node has an ACTIVATION THRESHOLD. After the activation threshold is reached, activation is divided between the node itself and all links headed by the node. The amount of activation leaving a node is limited and as activation is leaving a node it is divided between all links connected to the node (Anderson 2000). LAST differs from previous semantic-network models in assuming that the node itself participates in this competition so that the more links are connected to a node, the less activation will be allocated to any one link and to the node itself. Finally, LAST proposes the EQUITY PRINCIPLE, which states that the amount of activation allocated to a link is directly proportional to the strength of that link (found also in previous spreading-activation models, cf. Zeelenberg *et al.* 2003 for review). However, while the strength of a link is equivalent to the resting activation level of its propagation filter, the strength of a node, lacking a propagation filter, is fixed. Activation stored in a node or a PF is assumed to decay as time progresses. The decay function is exponential or power-law based (cf. Sikstrom 2002). Decay rate at a point of time is specific to the date of birth and size of a given ACTIVATION UNIT where an activation unit is a moving element defined by its current location as well as its time and place of origin. Activation units created recently decay at a faster rate than those created long ago and the larger the activation unit, the slower its rate of decay.

4. THE LAST ACCOUNT OF THE FINDINGS.

4.1. THE ARCHITECTURE: TOKEN FREQUENCY, LEXICON SIZE, AND SPEED OF PROCESSING. In priming, when the prime is presented, matching types are partially activated. The way this recognition process occurs is by matching the incoming token to already existing tokens (cf. Hintzman 1986, Johnson 1997, Pierrehumbert 2001 for similar proposals) such that more activation is allocated to tokens that are more similar to the incoming token. Since high-frequency types have more tokens, they will be activated more quickly and low-frequency types are more likely to be misrecognized as high-frequency types than vice versa. Whenever a type passes the activation threshold, a token node is created storing the information about that particular instance of the type, and activation starts to spread from the type node. If no type is activated, a new type is formed. Since the spread of activation from the node along type-token links occurs only after it has been activated, speed of the type node's recognition is directly proportional to its r-value: the lower the type node's r-value, the more input activation is needed to reach the level sufficient for recognition and the less input activation is coming in from the tokens. Thus, the greater the token frequency of a type, the faster its recognition should occur.

It has often been observed that logarithmically scaled frequency and not raw frequency has linear correlations with various dependent variables, reaction times in word recognition or lexical decision studies being one example. In LAST, what happens when token frequency of a type is increased by one token, is that the resting activation level of the type is raised and a new type-to-token link is acquired by the type. The more frequent the type,

the less activation will remain in the type node, hence the less its resting activation will be increased. In addition, the more frequent the type, the less activation will be allocated to the propagation filter of the newly formed type-to-token link.[5]

Once the prime type is activated, activation starts to flow out from it. As it is leaving the node, it is divided between the node itself and all links headed by the node, one of the links being tailed by the target, which has not yet been presented. Thus, the greater the number of links headed by the prime's type, the less activation will remain in the node and the less activation will be allocated to any one link. Given that every type is connected to all other types while a token is only connected to one type, the only factors influencing the number of links radiating from a type are its token frequency and the number of types in the lexicon. Therefore, the higher the token frequency of the prime, the less priming, including identity priming, should occur. Thus, the same process appears to be implicated in the prime frequency effect in priming as in habituation.

Slow recognition feeds back to low experienced token frequency since slow processors would not recognize as many tokens of a type present in the environment as fast processors and hence would have fewer type>token links per type, resulting in increased priming. In addition, the smaller the size of the lexicon, the more activation is allocated to any one node, hence more priming in children and late signers (as found by, e.g. Simpson & Lorsbach 1983, Emmorey *et al.* 1995, Nation & Snowling 1998, Castles *et al.* 1999), and faster recognition (and higher rated familiarity) of words learned early in life compared to words with the same token frequency learned later in life, indicating higher resting activation levels for early-acquired words (as found by, e.g., Brown & Watson 1987, Bonin *et al.* 2001, and Ghyselinck *et al.* 2004).

The finding that early-acquired words exhibit less identity priming (Barry *et al.* 2001) is predicted because when the lexicon is small, more activation will reach the propagation filter of a link when the nodes it links are co-activated. On the other hand, the proportion of activation received by the type node itself is constant because of the node's lacking a PF. Thus, LAST predicts that early age-of-acquisition should be correlated with having many strong associates, as found by Steyvers and Tenenbaum (2005).

4.2. THE EQUITY PRINCIPLE: NEIGHBORHOOD DENSITY, DENSENSITIZATION, AND BLOCKING. The Equity Principle states that the amount of activation allocated to a link is proportional to its strength (cf. Anderson 2000). If this is the case, we should predict that words that are semantically, phonologically, or orthographically similar to many other words, that is, words located in dense neighborhoods, should exhibit less priming than words located in sparse neighborhoods, since a link or node of a given strength will receive less activation in a dense neighborhood than in a sparse neighborhood. This is indeed what is found by Thomsen *et al.* (1996) for semantic priming and by Perea and Rosa (2000) for orthographic priming.

Even more direct evidence for the Equity Principle is provided by Anaki and Henik (2003), who find that if the target is given as an associate of the prime by a certain percentage of subjects in a free association task, there will be more priming between the prime and the target if the other associates of the prime are given by low percentages of the subjects

or if the prime has fewer associates than if other associates are also given by many subjects or many associates exist.

The Equity Principle also explains the blocking effect in associative learning: if an unconditioned stimulus (US) is already strongly associated with a conditioned stimulus (CS1), it is hard to associate with another conditioned stimulus (CS2) (e.g. Kamin 1969, Marchant & Moore 1973). This is because the linktron headed by the US and tailed by the PF of the CS2-US link has to compete with a strong US-CS1 link, relative to the case in which the US has no strong associates. Consequently less activation will be allocated to the CS2-US's PF when US is strongly associated with CS1, leading to slower strengthening of CS2-US.

Similarly, high-frequency CS1's and US1's are harder to associate with a CS2 or US2 because the PF's of links being acquired have to compete with many type-token links headed by CS1 or US1 (what are known as the CS pre-exposure effect and the US desensitization effect, cf. Hall 2003, Baysari & Boakes 2004).

Further evidence for the Equity Principle in associative learning comes from the interference paradigm of Barnes and Underwood (1959) and McGovern (1964), who found that when subjects are asked to learn a list of A–C stimulus pairs after learning a list of A–B pairs, they can recall B when presented with A worse than subjects who are asked to learn C–D pairs after learning A–B pairs.

Finally, the Equity Principle explains transitional probability effects (e.g. the ability to implicitly segment a speech stream into words based on only transitional probabilities present in the speech stream demonstrated by Aslin *et al.* 1998) without postulating that speakers calculate probabilities: a word that is very probable is a word whose connection to the previous word in the processing sequence is strong relative to its competitors.

4.3. SIZE-DEPENDENT DECAY; PERSISTENCE OF PRIMING, PRIMING ASYMMETRIES. A challenge to any single-mechanism account of priming is to explain why identity priming persists over several intervening items, while phonological and orthographic priming decay rapidly (cf. Stockall 2004). LAST handles this dissociation by assuming that the node from which activation spreads receives the lion's share of that activation. Since in LAST, the larger the activation unit, the slower the rate of decay, we predict that identity priming and priming that relies on stronger connections (relative to all connections headed by the source node) should decay less rapidly.

One untested prediction of this account is that identity priming should persist for a longer time if the primed unit is low-frequency than if it is high-frequency, if it has few neighbors than if it has many neighbors, and if it is in a large lexicon rather than a small lexicon. Some evidence for slower decay of activation in small lexicons is provided by the fact that children are commonly found to exhibit more perseveration errors relative to all errors produced than adults on both the phonological and the lexical levels (Stemberger 1989, Jaeger 2004).[6]

Size-dependence of decay rate also allows us to account for priming asymmetries. If larger activation units decay more slowly, less priming should be observed when the prime is high frequency, and the target is low frequency than when the prime is low frequency and the target is high frequency. The reason is that the major reduction in activation unit

size occurs earlier in a unit's lifetime when the prime is high frequency than when the target is high frequency. As a result, activation spreading from the prime decays more before target presentation when the prime is high frequency than when the target is high frequency, resulting in decreased priming.

5. CONCLUSION. LAST provides an explicit, testable account of frequency, neighborhood density, lexicon size, age of acquisition, target degradation, and speed of processing effects across tasks, domains, and species, using the single mechanism of spreading activation in a localist associative network, whose structure is independently motivated.[7]

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2 By 'amount of priming' we mean the number of milliseconds by which the reaction times to a word preceded by a related word differ from reaction times to the same word preceded by an unrelated word. Priming can be excitatory, when reaction times after a related word are faster than after an unrelated word or inhibitory when the reverse is true. The word whose reaction times we are measuring is called a target while the preceding related word is called a prime. The prime and the target may be similar in various ways: they can share acoustic characteristics, phonemes, letters, morphemes, meaning, or everything. Accordingly, we distinguish between phonetic, phonological, orthographic, morphological, and identity priming. On the sentence level, there is also syntactic priming, where the prime sentence and the target sentence share a syntactic construction, e.g., both are passive. Orthographic priming involves visual presentation of the prime and the target while phonological and phonetic priming involve auditory presentation. Morphological priming is often crossmodal, where the prime and the target are presented in different modalities.

3 Lines represent connections, width of line represents connection strength, filled circles represent nodes. The circle surrounding the type nodes has no theoretical significance.

4 If an r-value is negative, excitatory activation entering the node will become inhibitory when it leaves the node, where INHIBITORY activation reduces the r-value of nodes it enters. Linktron PF's are binary and non-trainable. The necessity of these properties of linktron PF's is shown in Kapatsinski (2005). A linktron can transmit activation by default but if any amount of inhibition is applied to its PF it does not transmit any activation. Transmitting activation (or inhibition) to a linktron's PF has no effect on the PF's resting activation level. Thus each linktron headed by a node A receives the same proportion of A's activation.

5 Calculations shown in Kapatsinski (2005) indicate that the r-value of type>token links must depend on the r-value of the type for the appropriate relations between the model's parameters to hold for all r-values of the (source) type.

6 Greater proportion of perseverations in small lexicons can be achieved even if the same decay rate is applied because the decaying activation unit is larger. However, this is unlikely to explain the persistence of identity priming: at a short delay, identity priming is no more than 3 or 4 times larger than similarity-based priming for near synonyms. Yet, identity priming can persist for a

very long time while semantic priming usually decays after one or two intervening items. The reason semantic priming can persist if the task involves much semantic processing (Joordens & Becker 1997) may be because the task draws attention to semantic representations, either allowing them to attract larger activation units, slowing the decay rate, or both.

[7] See Kapatsinski (2005) for a LAST account of type frequency and relative frequency effects.

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THE FRIENDSHIP OF THOMAS MORE AND ERASMUS

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In the fourteenth century, the printed books were mainly prayers in Latin. Even before the famous Gutenburg Bible, small printing shops in the Netherlands sold, to ordinary men and women at a low price, the prayers for them to say from day to day. Previously only the rich could afford a private copy of the prayers, made by the hand of a scribe. In church the laymen were not expected to know how to speak to God, in Latin or any other language, but some individuals absorbed by heart, through repetition, parts of the liturgy. As more private individuals had access to the holy books, it became an issue whether to pray in a native tongue or in the ancient one used by God's own spokesmen—as well as who should have access to the Holy Scriptures, and who is qualified to edit them.

A few reformers had tried to make religion accessible to Christians ignorant of Latin. John Wyclif and his pupils translated the Bible from Latin into English. John Hus in Bohemia wanted his people not only to be free from the rule of a German prince, but also to read the Scriptures in their native tongue, Czech.[1] For that treason or heresy, he was burned at the stake by a decree of the Council of Constance (1415).

The Christian faith could not be sealed up in any Latin text. Although the early Christians in Rome shifted gradually away from Greek to Latin—in daily life and in the practice of religion—the educated among them realized that the Latin language was secondary. But the study of Greek, to supplement one's Latin, was revived in the fourteenth century, and no longer required a sojourn in Constantinople. Learned Greeks had moved to Italy and brought good manuscripts of the *Iliad*, many other pagan classics, and the holy Scriptures.

One Netherlander fastened upon the need to compare the Gospel in Latin with the Greek original. Growing up in Rotterdam, he seldom used his Dutch name Gerrit Gerritszoon and avoided the language, except for communication with servants. He preferred distant contacts, to whom he wrote letters in Latin; when they met in person, they conversed only in Latin. His name was first recorded in Latinized form as Erasmus Gerardi.[2]

His most illustrious friend was Sir Thomas More, who resided near London and was an even more thorough Latinist.[3] More, unlike Erasmus, was married and spoke to his wife naturally in English; his letters to her, Maystres Alyce, were in English also. But to their children he spoke only Latin; to the oldest daughter, his letters (Thomas Morus Margaretae filiae suae charissimae) were most numerous, and she—even more than his male admirers and her sisters—wrote and sent him letters in Latin.[4]

A contemporary in France, Michel de Montaigne, was brought up with similar emphasis upon Latin. His eccentric father kept him from hearing any servant, and instead placed him under a tutor from Germany, who spoke only Latin.[5] But the father sent his son, at the age of six, to a school where the other boys spoke French. The result was happy for

literature: this boy read very widely and put his knowledge to use in a new and easy kind of composition, which he called an *essay*. It demanded nothing from a public of complete strangers, who might be barely literate; for in each essay the author supplied the needed information.

The success of the *Essays* by Montaigne invited imitation by an Englishman, Francis Bacon, who had studied the ancient texts in Latin and Greek. The form of the essay was very flexible; it enlisted an individual's serious thought, at no great length and without fictitious embroidery. Throughout the European world, essays became the most accessible texts for anyone to extend his understanding of things in general.

But in the age of Erasmus and More, the struggles of nations were intertwined with religion, and these two men were embroiled in controversies that they could not avoid. Martin Luther, an Augustinian monk in Germany, led a movement to reform the Christian liturgy and to express it all in the German language. He began, however, with the famous ninety-five Theses, which—being theological—were in Latin. They were so controversial that prominent men expressed either support for Luther or disagreement. What began as a regional war between Catholics and Protestants was taken up most heatedly in England. Henry the Eighth, the young king of England, stood out against the Protestants;[6] and the Pope, Leo X, gratefully conferred upon Henry the title Defensor Fidei in 1521.

A few years later, however, Henry, for deeper dynastic and personal concerns, rejected the supremacy of the Pope (Clement VII, who succeeded Leo) over the laws of marriage and divorce. Sir Thomas More had been appointed Lord Chancellor by King Henry in 1529, to replace Cardinal Wolsey. When the struggle within the royal family reversed everything in England, More was brought down, as were men even wiser. He would have preferred to stay out of any political dispute, and he resigned from office. But his precautions were in vain. He was pressed, either to agree with the king's claim of being head of the church, or to show what law, if any, limited the royal power. Although More did his best to evade the ticklish issue, he was trapped by an interrogator appointed by Henry to report More's words falsely.

The greatest lawyer in England mounted the scaffold with dignity and humor. He left behind a masterpiece, composed in his leisure and titled *VTOPIA* (No-Place). He was inspired by reports of sailors returning from distant islands. It was the last creation in Latin to win favor as a literary classic throughout Europe; it influenced political thinkers, even in the nineteenth century.

Martin Luther had a rare talent to wage and win a national or international religious controversy. For the common people of Germany, he gave something simple but literary and musical: hymns to cheer everyone in church. One of them, 'Ein feste Burg ist unser Gott', became a favorite outside of Germany as well.[7] Just as scholarly was his translation of the New Testament from Greek into German, and then the Old Testament from the Hebrew.

Erasmus managed not to take sides for or against Luther. His discreet mission, instead, was to spread knowledge of the ancient languages. His finest monument was an edition of the Greek New Testament (*Nouum Instrumentum*, printed in Basle, 1516), with his own exact translation into Latin, set beside the Greek. He did not directly call attention to the

discrepancies between the Greek original and the Latin version known as the Vulgate. But any reader, even if not very strong in Greek, could compare the text provided by Erasmus with the one most familiar in Latin manuscripts or printed books, and could thus recognise wherever the Latin is unreliable.

He undermined especially one argument of the Roman Catholic Church against the Greek Orthodox. In the Gospel according to John (15:26):

> "When the Paraclete [literally, advocate] comes, whom I will send to you from the father—the spirit of truth, which proceeds from the father—that one will testify about me."

Where the Greek text is:

τὸ πνεῦμα	τῆς ἀληθείας	ὃ παρὰ τοῦ	πατρὸς	ἐκπορεύεται
spiritus	ueritatis	qui a	patre filioque	procedit

the Latin Vulgate has, right after *a patre* 'from the father', an added word *filioque* 'and the son'.

Soon the Latin word *filioque* was tossed back and forth by the Catholic and Protestant disputants. Erasmus could not steer clear of them; he stated that in the Greek manuscripts he saw only παρὰ τοῦ πατρὸς but after it no equivalent to *filioque*. A spokesman for the Vatican retorted that the Greek equivalent και τοῦ ὑιοῦ is written at that point, in a manuscript belonging to the Papal library. Peaceably, Erasmus accepted this datum; and when his edition of the New Testament was reprinted, he incorporated the correction. Others remained suspicious of some deceit by their opponents, and eventually demanded that the manuscript in question be brought out for them to inspect with their own eyes. The custodians in the Vatican had to admit then that the manuscript had disappeared.[8]

Erasmus also, comparing the Greek and Latin languages, discovered that the medieval or Byzantine pronunciation of Greek was grossly at odds with the rendering of Greek names and other Greek words by Cicero and other ancient Latin authors. Erasmus and his followers thus restored some of the original sounds of Greek.[9]

Margaret More was nearly equaled in learning—or even surpassed—by the Princess Elizabeth, the second daughter of King Henry. He appointed Roger Ascham, from St. John's College at Cambridge, to tutor the royal children. Elizabeth was more clever than anyone before or after her. One exercise that was assigned to her has luckily been preserved from that century and for all time. She was given a Greek passage from the tragedy of Euripides, *Ἰφιγένεια ἡ ἐν Ταύροις*. The princess translated it into Latin, a language which, along with French and Italian, she already knew deeply. And her mastery of Latin never waned: In 1597, when she was sixty and had been queen for nearly forty years, an ambassador arrived from the king of Poland to complain that Polish ships and crews had been seized in England. The ambassador, in Latin, addressed the queen of England, who was sitting at Greenwich with her court.[10] She listened to the entire complaint; then she replied, 'Oh, quam decepta fui;

expectaui orationem; tu uero querelam mihi adduxisti…' and went on brilliantly in her own Latin vituperation, like Cicero denouncing Verres.[11]

Not by coincidence was the reign of Elizabeth the summit of English literature. Shakespeare, near the beginning of his career in drama, adapted the *Menaechmi* of Plautus freely to become *The Comedy of Errors*; and in *A Midsummer Night's Dream*, the amusing play within the play—the love of Pyramus and Thisbe—was based likewise on an episode in the *Metamorphoses* of Ovid, a Latin classic which everyone had read through at school, or had at least sampled. On a like theme, but more terribly powerful, Shakespeare produced the first of his great tragedies, *Romeo and Juliet*.[12]

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1 Hus was a pioneer, besides, in improving the orthography of a modern language. Heretofore, the educated among his countrymen were used to writing in German; and they carried over many conventions from German spelling to their own vernacular, such as the clumsy trigraph *sch* for the less frequent sibilant sound (which in the International Phonetic Alphabet is now shaped ʃ or š). Hus showed the difference from the ordinary consonant *s* by instead adding a dot above the letter *s*. Eventually his dot evolved to a more recognizable superscript ˇ called *haček*.

2 The double name Desiderius Erasmus was chosen, whether by himself or by his father. Desiderius was a modification of the Latin neuter noun *desiderium*. (The participle *desideratus* would have been more normal grammatically.) The equivalent Greek noun ἐρασμός (masculine) does not occur in the ancient and medieval texts but was valid as a back-formation from the derived adjective ἐράσμιος 'lovely'. Ἐρασμός became Erasmus, in Latin letters. The name Desiderius carried the implication that the child, although born outside the law of marriage, was wanted.

On the biography of Erasmus, my friend Arthur Tegelaar has sent me informative letters from his home in Oegstgeest (Netherlands).

3 Germain Marc'Hadour, 'Thomas More in Emulation and Defense of Erasmus', in *Erasmus of Rotterdam, The man and the scholar* (edited by J. S. Weiland and W. Th. M. Frijhoff; Leiden: E. J. Brill, 1988), 203–11.

4 Margaret More, on her own, translated into English a long prayer composed by Erasmus, *Precatio dominica in septem portiones distributa*. She, and possibly her husband William Roper, also composed in Latin, or finished a commentary, *De quattuor nouissimis*, on the final words of the Sermon on the Mount (Matthew 7:27).

5 Montaigne, in his *Autobiographie*, tells not much about his mother, Antoinette de Louppes, although she resided with him before and after his marriage and she outlived him. Her family was Jewish and had fled from Spain and settled in Toulouse and Bordeaux; they professed to be Protestant Christians.

6 *Assertio septem sacramentorum aduersus Martinum Lutherum, aedita ab … Henrico … octauo* (1521).

7 Some rules of standard High German have changed since Luther. Now it would be 'Eine feste Burg…'.

8 The missing manuscript was probably not a codex of the Bible, but a record from the Council of Nicaea (in the year 325), when the disagreements between the Greek and the Latin Church were thrashed out. My colleague and friend, Prof. Daniel Williman, has been very helpful to me.

9 The Greeks of Constantinople learned of this 'Erasmian' challenge to their Byzantine tradition, mainly in the eighteenth century, when the sons of wealthy Greek families studied at the universities of Italy. See pages 169–70 of my article, 'The Perennial "Language Question" among the Greeks', in *General Linguistics* 27 (1987):162–72.

10 The ambassador was no doubt aware that this queen was highly educated; so there was no need to speak French, as was usual among ladies anywhere in Europe. Lytton Strachey, in *Elizabeth and Essex*, summarizes the incident from the point of view of the main character.

11 Elizabeth's speech, or at least an abridgement of it, was recorded at the time, and much later published by John Nichols (ed.), *The Progresses and Public Processions of Queen Elizabeth* (London, 1823; photo-reprint, New York: Burt Franklin [1970]) III, 417.

12 In one scene of the 'historical' play *King Henry the Fifth*, Shakespeare has the French princess Katherine trying to learn a little English from her attendant Alice. Later in the action, Henry gently flirts with his bride-to-be, as she replies to him in a broken mixture of both languages.

ON THE PSYCHO-SOCIOLOGICAL REALITY OF DISCOURSE TEMPLATES

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Presumably, the capacity to produce narratives, whether first-hand accounts of experiences, reports, or stories and the like, is so ingrained a characteristic in human nature that it could be considered to contribute to a definition of our very humanity. Homo sapiens is homo narrans. As far as I know, chimpanzees do not tell stories.

The main theme of this paper perhaps belongs to the genre history of ideas, in that it attempts to capture some conceptions about our narrative capacity that have been around for a long time. I delay, however, the development of the main argument in order to address certain problems in narrative analysis.

1. Some problems in narrative analysis.

1.1. Accusations of circular reasoning. Discourse Analysis is sometimes accused of being based on circular reasoning. For example, in the analysis of narrative, a storyline is assumed to be marked by past tense and past tense is assumed to manifest the storyline, i.e. A implies B and B implies A. Of course, it may happen that the storyline tense can not always be so simply defined; it could, for example, be past tense only in main clauses. But the criticism would not be too seriously blunted by such qualifications.

1.2. Circularity and storylines in narratives. We can, however, dispose of the accusation of circular reasoning somewhat as follows:

(a) We can start empirically with the fact that narration involves happenings reported in chronological sequence. We then raise the question, how is this chronological sequence encoded in the languages of the world? Then it can be argued that what we have reason to call the storyline, i.e. the reporting of a chain of consecutive punctiliar happenings in a narrative, is in some way foregrounded by some linguistic feature(s) in narrative text in the language that we are analyzing. In many languages we find that a given tense/aspect marks the storyline in the text. Furthermore, as some have argued, we can even put the argument more strongly, i.e. it can be argued that the motivation for a tense/aspect system is to mark necessary discourse functions. Thus Ricoeur (1985:61–77), following Weinrich (1964), argues that the tense/aspect system in such a language as French is intended to contribute to the followability of a story. Thus, in contemporary English, the storyline of a narrative is normally marked by simple past tense forms. In this respect, A (the simple past tense) $\supset$ B (the storyline).

(b) A biconditional proposition may, however, need to be recognized here. It can be argued that the storyline calls up the simple past tense, i.e. $B \supset A$, thus leading us to posit $A \equiv B$. Biconditional propositions are not a violation of logic but a necessary part of it. Indeed, as such, they take their place in rudimentary works on logic, where they are called coimplication or logical equivalence. See, however, (4) below regarding an important qualification at this point.

(c) The necessary empirical reason for suggesting that we have here a biconditional proposition is that the storyline, i.e. what is marked as a chain of chronologically successive events, is, after all, emic to stories in a given language. It is impossible to frame an etic notional chronological sequence that conforms to what is marked as storyline in every language. Biblical Hebrew, for example, marks as storyline (with the *wayyiqtol* form) some things that English prefers to put into subordinate clauses and thereby off the storyline. It is pointless to argue from the relative importance or non-importance of an event in one language to its storyline status or non-status in another language.

(d) It is necessary to realize, however, that although a given tense or aspect may quite regularly mark the mainline of a discourse type, the identification is only approximate. Consequently, the biconditional proposition suggested here establishes simply a norm or the unmarked choice that is subject to departures. For example, at the high point of a story the regular storyline verb form of a narrative may not occur. Instead, we may observe some other form that is appropriate to marking such a point. Furthermore, we must allow for what I have called PROMOTION to the storyline. Thus, although normally a past progressive verb would not be on the storyline in an English narrative, it may be promoted to the storyline by a punctiliar adverb. Thus *was insisting* would not normally be storyline, but background; yet with the punctiliar adverb *suddenly* it can be storyline: *Suddenly he was insisting on the point with great fervor*. Likewise past perfect tenses in English normally encode flashbacks in a storyline. But, again, with a punctiliar adverb such a form can be promoted to storyline: *Suddenly, he had realized what he so long had desired*. Again, descriptive clauses with the verb *be* in English are normally quite removed from the storyline but with a punctiliar adverb may be promoted to the storyline: *Suddenly he was his old self again*.

But just as verb forms which normally would not be storyline can be promoted to storyline status, so potentially storyline verbs can be demoted by grammatical subordination, i.e. by putting them into subordinate clauses, as noted for English above. By promotion and demotion the narrator can further shade his ongoing use of verb forms, like a resort to orthographic bolding or italicizing. Some of these concerns are illustrated in the short text considered below.

2. THE NARRATIVE TEMPLATE. It is the special concern of this paper to show that the matter of the existence of storylines and storyline forms has roots in our psycho-sociological reactions as interacting human beings. It is in reference to these reactions that the concept

of 'story' is realized in our everyday life, and that some sort of narrative template proves initially relevant. We then further emphasize the relevance of such a template by tracing its development from ancient times and its emergence in the literature of our discipline.

If I have a colleague who comes up to me and says pointedly 'Do you know what happened to me yesterday?', I don't expect him to launch onto a routine recital of how he got up, showered, shaved, dressed, had coffee and doughnuts, and went to the office. In fact, if he is addicted to inflicting such recitals on his friends, we might have reason to doubt whether the man was entirely normal. While such routine recitals may be relevant on the witness stand in a courtroom, in normal everyday interactions, we expect to be told that something occurred which was unplanned and broke his routine with certain possible out-of-the-way consequences. We can then realize 'Thereby hangs a tale'. And we further expect that the complications and problems will be at least partially worked through and resolved in some way. In brief, a rudimentary sense of a narrative template (or schema) is built into us: i.e. we expect some sort of Inciting Incident (which breaks routine), building into Developing Conflict which leads to a Climax, and Denouement (cf. Longacre 1976, 1983, 1996).

Furthermore, we expect that in even such informal accounts there will be a sequence of actions some of which are elaborated, e.g. with statements of cause or result, or interpreted with paraphrase or reinforcement, or in some way commented on. There must, however, be some way to distinguish the actions proper from elaborations of them—otherwise a story would be UNFOLLOWABLE (Ricoeur 1985:61–77).

Having got this far, we have granted most of what a narrative analyst insists upon. We have established that there is a narrative template that has a certain psycho-sociological reality, and that the texture of a narrative, whether spoken or written, has some built-in way to let us follow the story. The narrative analyst further elaborates the tools of his craft starting from these basic concepts. Whether concerned with the analysis of a simple folktale from a folk culture or a complicated contemporary novel in English, French, or Russian—i.e. whether the plot is simple or multiple, and whether the story moves steadily forward or is given with backtracking and projection—we expect a narrative template to be involved, whatever the skill with which the narrator may embellish the basic schema. We also expect that there will some way in the story to distinguish the storyline proper from explanations and elaborations of it.

Consider, as an example, the following story:

> '(1) I *made* my usual trip to the supermarket this past Tuesday. (2) I *parked* the car, *entered* the store, *grabbed* a shopping cart, and *made* my usual passes up and down the various aisles. (3) While meditating on the higher prices of some staple items and picking up a few bargains in the process, I *mounded* the cart high with my purchases. (4) Coming to the checkout counter I was fourth in line with other people having similar orders. (5) Finally, when I got up to the cashier, everything *was tallied* and I *was presented* with the bill. (6) I *reached* into my purse for my wallet—and it wasn't there! (7a) My first thought was theft; there must have been a pickpocket in the crowd, (7b) but then I soon *realized* that the simple truth was that I had left my wallet on the dresser at home. (8) So there I was, without cash,

> checkbook or even a credit card. (9) With much chagrin I *confessed* my predicament to the cashier, then *asked* him to keep the shopping cart and its bundled and sacked purchases right there while I went up to see the manager at Customer Service. (10) They were able to put my shopping cart and its purchases aside for me while I went home to get my wallet. (11) I *came back*, *paid* my bill, and finally *got* my stuff out to the car. (12) I never have felt so humiliated and stupid for a long time!'

Note first of all that this paragraph qualifies as a story in that it tells us not simply of a bare routine of supermarket shopping but of how the routine was shattered by the narrator's discovery that she had no means to pay for all the groceries and household goods that she had just checked out. But at this highpoint of the story the narrator, instead of saying 'I *discovered* that I didn't have my wallet', simply says 'it wasn't there'. I note in passing that this is one of the ways of marking such a highpoint, viz., by omitting the storyline verb that is implied and reporting baldly what she discovered in that instant. It's similar to a quotation in which the quotation formula is elided. Sentences prior to this moment-of-discovery sentence report the customary moves of a shopper as storyline (with storyline verbs italicized). Sentence (7) is antithetical. Clearly, the second part of the sentence, (7b), is on the storyline by virtue of the simple tense verb *realized*. But what about (7a)? Implicitly the two parts of sentence (7) are not only in contrast but are marked as constituting a sequence, which could be paraphrased: 'First I thought X, then I realized Y.' But instead of a simple past tense verb *I thought* we find a nominalized form of the verb, i.e. *(my first) thought*. Again, the irregular expression of the cognitive event (realization) may be attributed to its being portrayed as climax. So both (7a) and (7b) can be construed as storyline distorted by climax. Sentence (8) is, however, clearly summary and depictive rather than storyline. The reason for assigning this sentence to such summary status have to do with the functions of the verb *be* in most languages. That is, such stative verbs do not report events but are commonly expository/descriptive. In sentence (9) the storyline resumes with the verbs *confessed* and *asked*. In the same sentence, however, there is a simple past tense in a subordinate temporal clause: *while I went up to see the manager at Customer Service*. Here what could have been a storyline verb *I went up* is grammatically demoted by its occurrence in an adverbial clause. Sentence (10) simply reports as the resulting situation *They were able to...* It also contains a subordinated clause that demotes what could have been a storyline verb *I went home...* Sentence (11) contains three storyline verbs: *came back*, *paid*, and *got*. Sentence (12) is commentary rather than storyline.

All the above illustrates the clues whereby a reader picks his way through a narrative with recognition of the storyline versus background material. At the same time it illustrates how storyline verbs may be demoted by grammatical subordination, and elided and metamorphosed at a high moment of the story without the hearer/reader losing track of what is going on. The hearer/reader is alerted to the importance of that moment in the story by the omission of a storyline verb or some such device.

3. HORTATORY VERBS AND THE HORTATORY TEMPLATE. Similar arguments can be marshaled in support of a cognitive template for hortatory or persuasive discourse. It is argued

here that there is a hortatory template with a line of exhortation that is somewhat more varied (and often disguised) than is the mainline of narrative discourse.

Giving advice or issuing commands to our fellows often characterizes social relations. The advice-giver may be motivated by benign concerns for one's fellow human beings or by the desire to dominate—or by some combination of the two. Since our fellow human beings may not like to receive exhortation, the line of exhortation may be mitigated or somewhat disguised, as observed above. For these reasons the analysis of hortatory discourse may present more challenges than the analysis of narrative. Before getting into these further matters it is helpful, however, to examine the hortatory template.

Again we fall back here on everyday conversational realities to present this template. Suppose someone in the family, or workplace comes up to you and says, 'I've got something I want to talk to you about'. There has to be some sort of precipitating situation to provoke this person to take you into the corner and talk to you this way. Furthermore, the advice-giver is gambling (in terms of personal relations) that you will feel disposed to listen; a miscalculation here may impair a relation or a friendship! Here, two elements of the hortatory template emerge: (1) the Situation out of which the exhortation springs, and (2) the Prerogatives of the advice-giver (i.e. the EXHORTER); what right does he/she have to give advice to the advice recipient (i.e. the EXHORTEE)?

Two further elements enter into the hortatory template: (3) the Command element proper (however mitigated and disguised) and (4) Motivation cited for obeying the command, which characteristically breaks down into WARNING ('You'll do well to take my advice or the following negative things may happen to you') and PROMISE ('You can expect the following positive results if you heed my advice'). Occasionally motivation is an appeal to NEED in the lives of ourselves or others (Longacre 1996:34, fn. 2).

Our claim here is that hortatory discourse, the world over and throughout time, essentially conforms to this hortatory template. By means of such discourse we urge fellow human beings to stop doing something that they are doing, or to do it less frequently, or to do something they are not presently doing, or to do whatever is already being done more regularly, more fervently, or with greater effectiveness. Not essentially different is persuasive discourse, in which we attempt to change beliefs or values of a fellow human being. Again, moreover, this discourse template is not an artificial construct of the analyst, but a natural outgrowth of everyday social relations.

4. FURTHER POSSIBLE DISCOURSE TEMPLATES. I will not elaborate further possible templates for other discourse types. They are not necessarily as well defined as for narrative and exhortation. I note in passing, however, that Winter and Hoey suggested years ago a template which, in my opinion, is especially apt for expository discourse, viz, (1) Situation, (2) Problem, (3) Solution, and (4) Evaluation (Hoey 1983).

Discourses built on this template range all the way from such ancient writings as the Hebrew Bible (e.g. Psalm 107) to a contemporary piece of phonological or grammatical linguistic argumentation.

5. A 'CONVERGENCE' ARGUMENT FOR THE PSYCHO-SOCIOLOGICAL REALITY OF DISCOURSE TEMPLATES. A further argument for the reality and relevance of such templates as those posited above is seen in the convergence of schemata posited for discourse by varying literary and linguistic/textlinguistic investigators. Furthermore, it can be argued that such convergence on discourse schemata is closely parallel to similar developments in other levels of linguistic structure.

5.1. CONVERGENCE IN REGARD TO PREDICATE RELATIONS. Charles Fillmore's 1968 article 'The case for case' dropped a germinal idea back into linguistics, an idea that was swiftly elaborated, modified, and even simplified by others such as Chafe (1970), Platt (1971), Grimes (1975), Cook (in a series of articles from 1970 on, culminating in Cook 1979), Anderson (1971), Hale (1973), Pike and Pike (1977) and other more recent writers such as myself. This was a stimulating foment of development in which I will not attempt to sort out the relative dependence or independence of the various writers. The fact that the various catalogues of case relationships (e.g. agent, patient, experiencer, and instrument), differ somewhat from linguist to linguist is no argument for rejecting the whole idea of the relevance of such categories. Rather, on the contrary, the differences and overall similarities among the catalogues posited by various researchers can be cited to argue for the ultimate validity of such distinctions; i.e. that all of them are roughly similar and can be considered to converge on linguistic reality. They rate as discoveries, not merely as artifacts of the linguistic profession. Furthermore, they have become stock and trade of subsequent discussions as seen, e.g. in the development of the idea of ergativity. So it has become established that at the clause level of linguistic analysis, i.e. within predications, there are ROLES which as semantic categories are analytically relevant but do not occur in one-to-one correspondence with grammatical relations.

5.2. CONVERGENCE IN REGARD TO INTER-PREDICATIONAL RELATIONS. A similar convergence has taken place in reference to relations between clauses/predications in sentences and paragraphs, whether such relations are referred to rather colorlessly as 'relations between clauses', 'rhetorical structures', 'rhetorical predications' or 'semantic relations'.

Beekman (1970) may be the unsung hero and innovator in this regard. Beekman's original stimulus was Fuller (1959), but he elaborated considerably beyond this starting point. While conducting translation workshops in Ixmiquilpan, Hidalgo, Mexico under the auspices of the Summer Institute of Linguistics, Beekman brought research workers into his office and questioned them closely as to what semantic relations such as coordination, contrast, purpose, and means-end were recognized in the surface structure of the language being studied. If a relation was recognized in the surface structure of one language, even if not so marked in the next language, then Beekman entered it into his catalogue of semantic relations. The list grew empirically and surely.

But Beekman's work did not stand alone for long. Ballard, Conrad and Longacre (1971a and 1971b), Longacre (1976), Beekman and Callow (1974). Grimes (1975), van Dijk (1977), Halliday &Hasan (1976), and Mann and Thompson (1983, 1987a, 1987b), and Mann, Matthiessen, and Thompson (1992) have all contributed to a foment not dissimilar to that

mentioned above in relation to so-called case grammar. Just as in case grammar the predicate calculus of formal logic was enlarged to adapt it to clause-level linguistic relations, so in the study of interclausal relations the statement calculus was enlarged and adapted to linguistic relations within the sentence and paragraph. Again, the similarity and variety of semantic/rhetorical relations that are posited by various scholars leads to the belief that all of us together have been converging on categories that are linguistic realities.

5.3. A GROWING CONVERGENCE IN REGARD TO DISCOURSE-LEVEL TEMPLATES. Is it not possible that suggestions by various of us (beginning with Aristotle) are converging on discourse level realities just as previous work has converged on relations on lower levels? Do we have something like the convergence noted above for case grammar on the clause level and interclausal relations on the sentence and paragraph levels? Certainly, something of this sort can be noted.

In regard to these developments, Aristotle is undoubtedly the fountainhead; his *Poetics* describes, in effect, a rudimentary template which he presents in relation to drama, but which can be expanded to apply to narrative of a non-dramatic variety. This template is at first adumbrated with seeming innocuousness as the observation that a drama must have a beginning, a middle, and an end with causal relations between the parts. But part one is given as the *agon*, part two as the *pathos*, and part three as *epiphania*. T. Porter (1986:101) identifies the agon as the initial confrontation, violation of a taboo, broadly paraphrased as 'the time is out of joint'; it might be broadened to imply danger. The pathos is the struggle itself, where in tragedy the hero suffers and loses out, typically forfeiting his life (cf. Harrison 1962). The epiphania is revelation/restoration of order at great cost to the hero.

This simple apparatus is inherent in the structure of Greek drama and subsequent drama as explained by Holman and Harmon: 'the major parts of Greek plays were distinguished by the appearance of the chorus, and they generally fall, as Aristotle implies into five parts' (1986:4). They go on to say that Seneca and Roman drama likewise had a five-part model, which comes over into Elizabethan times as the five-act play. Then they comment, 'In varying degrees the five-act structure corresponds to the five main divisions of dramatic action: EXPOSITION, COMPLICATION, CLIMAX, FALLING ACTION, and CATASTROPHE'. I would interject here that catastrophe is simply the type of denouement we expect in tragedy, while in comedy we can expect other sorts of UNTYING of the knot represented in the climax. Here French literary nomenclature has two balanced terms *nouement* and *denouement* that we lack in English.

Another schema frequently encountered is commonly referred as Freytag's Pyramid (Freytag 1863), which I reproduce in **Figure 1** (overleaf) as given in Holman and Harmon (1986; see the original, edited by Thrall and Hibbard in 1960).

Several things can be said about this schema: (1) It basically is a schema of rising and falling action with climax as the turning point. (2) It starts with an Inciting Moment, which is somewhat similar to the 'tragic flaw' or unwitting misstep (the *hamartia* of Greek drama). (3) The falling action has reversal (~denouement) and catastrophe—but as we have seen this is restricted to tragedy, while comedy (a happy ending) involves a different sort of denouement.

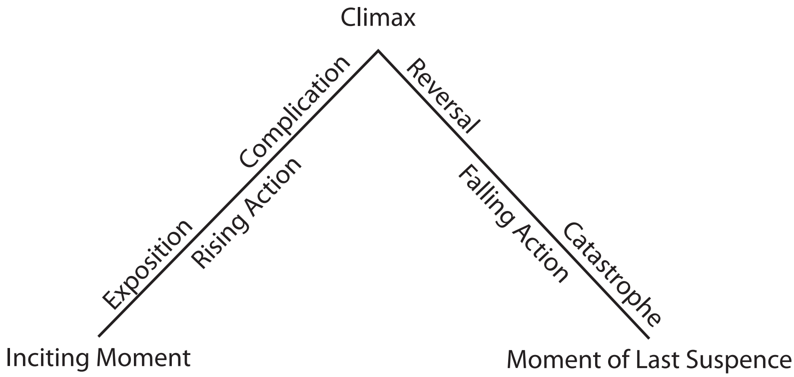

***Figure 1.** Freytag's Pyramid.*

My own work as early as 1976 and as late as 1996—as well as some others who have followed my lead—is indebted to Artistotle and his subsequent adaptations. While this schema has, in effect, been partially given above, I give it here in fuller form with a free paraphrase of its elements:

Exposition: 'Lay it out'
Inciting moment: 'Get something going'
Developing conflict: 'Keep the heat on'
Climax: 'Tie it up proper'
Denouement: 'Loosen it'
Final suspense: 'Keep untangling'

This template has been applied not only to folktales and traditions in a variety of languages around the world, but to current writing in the contemporary world. Thus a group of us in 1978 applied this approach to Arthur's Hailey's 1959 novel, *The Final Diagnosis,* (with a partial analysis belatedly published as Longacre 2004). Here the main elaboration consists in the fact that a work of this length has an overall plot and several subplots, and the above apparatus must be applied to all of them.

An independent and variant tradition of narrative analysis harks back to Vladimir Propp's *Morphology of the Russian Folktale*, first published in Russian in 1928 but not translated into English until 1958. Propp's work, because of the unfortunate translation lag, has had a delayed effect on the linguistic/textlinguistic scene in Europe and America. Colby (1973) is much in the Propp tradition. These authors break down the narrative components—whether functions (Propp) or eidons (Colby) into a great number of component pieces. In the case of Propp the total number is 33. But it is noteworthy that in summations or appendices at the end of both works, the overall picture is reduced to something on the order of the template that I suggest here. Thus, Propp presents Appendix 1 ('Materials for the tabulation of the tale'), and Colby (1973:652) Table 1, where motivation, engagement, and resolution are presented as groupings of the successive actions. Similar to this approach

is Lord (1960), where Lord's themes are similar to Propp's functions and Colby's *eidons*. Lord (1960:94) recognizes, however, a higher unity into which the themes fit: 'Although the themes lead naturally from one to another to form a song which exists as a whole in the singer's mind with Aristotelian beginning, middle, and end, the units within this whole, the themes have a semi-independent life of their own'. Labov (1967) and those following his lead (cf. Bamberg 1997) represents a further analytic tradition which is not incompatible with the template suggested here. An interesting element in his schema is that between complication and resolution Labov posits a SUSPENSION POINT that is evaluative and impresses me as being a marker of climax, i.e. maximum tension. Again, I believe that in all these admittedly different approaches there is something approaching a convergence.

I summarize my case for the psycho-sociological reality of discourse templates with a dual claim. (1) Discourse templates are not daisy chains woven by imaginative linguists, but part and parcel of our perceptions in social relations and hence arguably belong to our basic makeup as interacting human beings. (2) Furthermore, literary critics since Aristotle and linguists of various contemporary schools display a convergence on what is roughly a common schema which is a further realm of linguistic reality beyond the grammar of the clause, sentence, and paragraph.

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GOOGLING SHAKESPEARE: SHAKESPEARE'S EFFECT ON CURRENT ENGLISH

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[Dedicated to the memory of Miss Joiner,
my high school Latin teacher]

AT LACUS XXXI A SPEAKER referred to differences in the Latin inscriptions at Chicago's Art Institute and Museum of Science and Industry. This brought back a memory of my high school Latin class in suburban Chicago. The teacher made Latin come alive by encouraging us to search for influences that Latin and the culture of ancient Rome had on present day culture. I remember roaming Chicagoland and taking pictures of such influences, such as the statue of Ceres, the Goddess of Grain, atop the Chicago Grain Exchange (now the Board of Trade) Building. She would have loved J.K. Rowling's *Harry Potter* books, where all the magic incantations are in Latin, and the names of many characters come from Latin (e.g. Lupus) or Roman mythology (e.g. Cerberus). And, of course, she would have been happy that we named our group LACUS!

This was the germ of the idea that led to this paper; namely, looking for the influence of Shakespeare on modern-day English. The method I have used is to search the Web using the Google search engine with the wild card symbol asterisk to find expressions in which one or more words are substituted (Reich 2005). The theme of this meeting is Networks; after the human brain, the World Wide Web must by now be the second most complex network involving human language.

I hope to demonstrate to the reader the extent to which Shakespeare remains a part of our culture. In what follows, the numbers are Google's estimates of the number of occurrences of the expression in question on the Web at the time that I did the search.

The most common quotation from Shakespeare is *to be or not to be* from Hamlet. This appeared 818,000 times. As I demonstrate in Reich 2005, common expressions are often extended by using the same syntax but substituting a different word in one or more places. The Google expression {`"to * or not to" -be`} finds all paraphrases of the expression in which the verb *be* is replaced by another word. There were 740,000 such paraphrases, which is 47% of the total uses. Examples (1)a–i give one an idea of the range of uses to be found on the Web.

(1) a. *To fake or not to fake, that is the question.*
b. *To outsource or not to outsource, that is the question.*
c. *To diet or not to diet, that is the question.*
d. *To call or not to call, that is the question.*
e. *To move or not to move, that is the question.*

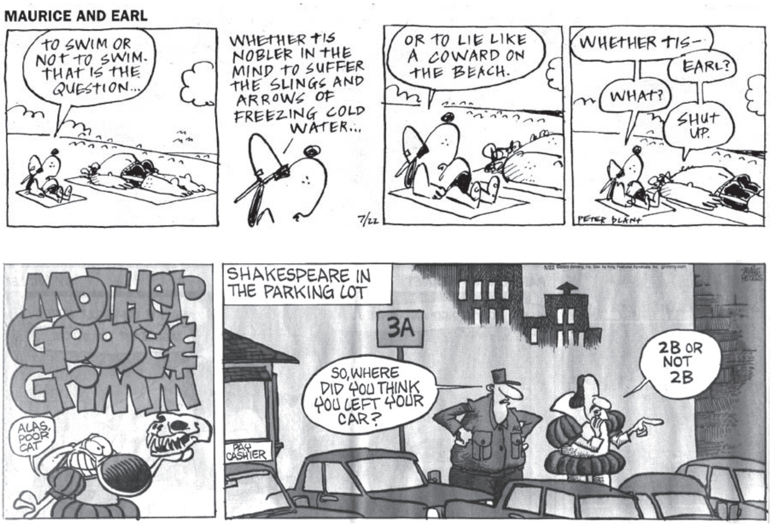

Figure 1. *Cartoon references to Hamlet. (Maurice and Earl © 2005, Peter Plant. Reprinted by permission. Mother Goose and Grimm © Mother Goose - Grimmy, Inc. King Features Syndicate. Reprinted by permission.)*

(1) f. *To believe or not to believe, that is the question.*
g. *To spank or not to spank?*

The following example is the title of a *Time Magazine* article on honey, which asks:

(1) h. *To bee or not to bee?*

One particular example appeared on the internet in 175 places [here the *s are my editorial modification]:

(1) i. *To f**k or not to f**k, that is the question.*

One can find quotes in all sorts of places. The cartoons in **Figures 1** appeared in my daily newspaper.

One interesting example (**Figure 2**) was written on a series of chalkboards hanging from the ceiling of a local Toronto restaurant (East Side Mario's, Eglinton Town Centre). Notice that the person who put them up could quote Shakespeare, even though s/he could not spell a simple two-letter contraction on the fourth board.

The next most common quotation that I found comes from *As You Like It.* This exaggeration has become so much a part of the language that people are not even aware that it comes from Shakespeare; the expression is *forever and a day*. Google estimates indicate that it appears 396,000 times. Mindful of Victor Borge's 'twoderful' comedy sketch about

Figure 2. *Signs at a Toronto restaurant (photos by the author).*

inflationary language (*http://www.whysanity.net/monos/victor_borge.html*), I searched for examples of {`"forever and * days"`}. Indeed, there are about 18,500 examples, as in (2)a–i:

(2) a. *forever and two days*
b. *forever and three days*
c. *forever and five days*
d. *forever and 10 days*
e. *forever and 12 days*
f. *forever and 20 days*
g. *forever and forty days*
h. *forever and a trillion days*

But my favourite example on the Web is somewhat less than a trillion:

(2) i. *forever and 2.6 days*

The third most common expression that I found also comes from *As You Like It.* It is *all the world's a stage,* and it appeared approximately 127,000 times. The Google expression {`"all the world's a" -stage`} revealed 18,200 extensions of the expression, examples of which are shown in (3)a–h:

(3) a. *All the world's a page.*
b. *All the world's a phage.*—[on bacteriophages]
c. *All the world's a cage.*
d. *All the world's a stooge.*
e. *All the world's a critic.*
f. *All the world's a blog.*
g. *All the world's a 32-bit machine.*

Note that the first four examples sound similar to the original quote. The occurrence of such examples is evidence that there is conscious copying of the original quote. My personal favorite, however, is the substitution of a truly esoteric word:

(3) h. *All the world's a googlewhack.*

For those who are not familiar with this term, a *googlewhack* is a Google search for two words that when entered into the search expression, yields only one result.

The next example comes from *Hamlet*—namely, *to thine own self be true.* There were 160,000 such occurrences. There are three possible places to make a substitution: *thine, self,* and *true.* The pronoun is *thine* because is precedes a word beginning with a vowel. This rule is obsolete in modern day English; the only common exception is the line from the hymn: *Mine eyes have seen the glory of the coming of the Lord.* For this reason, I searched for the expression *to thy own self be true* and found another 653 examples. The sum of the extensions yielded about 2810 examples, a few of which are seen in (4)a–g.

(4) a. *To thine own self be fabulous*
b. *To thine own self be gentle*
c. *To your own self be true*
d. *To thine own sole be true*—MichiganRunner
e. *To thine own shelf be true—Complete Closets Guide*
f. *To thine own self be untrue*—Univ of Manitoba Psych. Dept.
g. *To thine own self be cruel*—'masochist's motto'

My favorite, however, comes from the website of The American Society for Cell Biology, advertising a t-shirt (**Figure 3**).

Another Hamlet quote is *Alas, poor Yorick, I knew him Horatio.* There are 61,100 occurrences of *Alas, poor Yorick,* and another 186,000 of variations, including (5)a–i:

(5) a. *Alas, poor Psion, I knew him well.* ["Psion Exits the Handheld Market"]
b. *Alas, poor SQL, I knew it well.*
c. *Alas, poor TiVo, I knew thee well.*
d. *Alas, poor Darwin*
e. *Alas, poor Gingrich*
f. *Alas, poor Microsoft* [poor?]

Figure 3. *'To thine own cell be true' T-shirt from the American Society for Cell Biology website.*

(5) g. *Alas, poor OS/2; I knew it, Horatio.*

See also the first panel of **Figure 2**. Appropriate to this paper are:

(5) h. *Alas, poor Shakespeare, I knew him well*—Ole Miss English Department
i. *Alas, poor Shakespeare, we hardly know ye.*

From *The Merchant of Venice* come 35,000 examples of *All that glitters is not gold.* There are two content words that may be substituted for. Even if both substitutions are made, the allusion to Shakespeare remains. There were 11,000 examples of these, examples of which are given in (6)a–h:

(6) a. *All that glitters is not silver.*
b. *All that wheezes is not asthma.*
c. *All that slithers is not cold.*
d. *All that Sparkles is not Champagne.*
e. *All that palsies is not Bell's.*
f. *All that wiggles is not hyperactive.*
g. *All that convulses is not epilepsy.*

By now, the reader will understand why my favorite example of such extensions is (6)h:

(6) h. A*ll that googles is not gold.*

From *Hamlet* one finds 66,900 examples of *Brevity is the soul of wit.* I found another 12,500 examples of extensions, including (7)k–i:

(7) a. *Impropriety is the soul of wit.*—Somerset Maugham
b. *Digression is the soul of wit.*—Ray Bradbury

(7) c. *Abundance is the soul of wit.*—Mennonite Life
d. *Artistry is the soul of wit.*
e. *Levity is the soul of wit.*
f. *Brevity is the essence of wit.*
g. *Brevity is the source of wit.*
h. *Brevity is the soul of lingerie.*
g. *Brevity is the soul of blogging.*

Among these extensions, I must admit to having two favorites. The first is found on a button for sale on the web, and the second appears on a website discussing bad writing:

(7) j. *Repetition is the soul of wit. Repetition is the soul of wit. Repetition…*
k. *Being short and to the point and not using too many words is the soul of wit.*

The next quotation comes from *Romeo and Juliet.* There are approximately 20,900 occurrences of *Parting is such sweet sorrow.* A few of the over 10,500 utterances modelled on this quote are shown in examples (8)a–i.

(8) a. *Parting is such suite sorrow.*
b. *Parting is such cheap sorrow.*
c. *Parting is such constant sorrow.*
d. *Departing is such sweet sorrow.*
e. *Pouting is such sweet sorrow.*
f. *Upgrading is such sweet sorrow.*
g. *Parking is such street sorrow.*
h. *Suing is such sweet revenge.*

And my personal favorite in this category is the 291 occurrences of (8)i:

(8) i. *Farting is such sweet sorrow.*

An example that refers to the plot of *Romeo and Juliet*, though not the quotation under consideration, is shown in **Figure 4**.

One of Shakespeare's sonnets, Sonnet 18, is quoted 20,000 times on the internet. It is: *Shall I compare thee to a summer's day?* While the number of extensions is not large at 686, some of the following are notable examples of doggerel.

(9) a. *Shall I compare thee to a rose bouquet?*
Thou art more fragrant and less thorny.
b. *Shall I compare thee to a multinational*
Thou art more arrogant and polluting
Rough winds remind me to be rational
As global warming starts to put the boot in.

Figure 4. *Cartoon reference to* Romeo and Juliet. *(© Tina's Groove - Rina Piccolo. King Features Syndicate. Reprinted with permission.)*

(9) c. *Shall I compare thee to a winter moon*
Or the rare cactus flower that dies in June?
d. *Shall I compare thee to a stilton cheese?*
Thou art more fragrant and more likely to melt:
Rough wax does bind the squishy lumps of grease,
And rounds of curds do fill the bloated belt.
e. *Shall I compare thee to a feathered friend?*
Or to a roasting fowl with all thy feathers plucked!
f. *Shall I compare thee to a bale of hay?*
Thou art more dusty and far less neat.
Rough winds do toss thy mop about, I'd say,
Which looks far worse than hay a horse would eat.
g. *Shall I compare thee to a cloudy sky*
Thou art more obscure and much more dry!
h. *Shall I compare thee to a winter's night?*
Thou art much clearer, crisper, yet less cold:
Before thine image entered my sight,
The finest view I ever did behold.
i. *Shall I compare thee to a windy day?*
j. *Shall I compare thee to a managed fund?*
k. *Shall I compare thee to a Unix box?*
l. *Shall I compare thee to a Sony walkman?*

And the award for most amusing goes to (envelope please):

(9) m. *Shall I compare thee to a hanging chad?*

Romeo and Juliet is the source of another very famous quote, *A rose by any other name would smell as sweet,* which occurs 19,400 times. Variations on this theme occur another 8,620 times, including (10)a–g:

(10) a. *A soap by any other name would smell as sweet.*
b. *A nose by any other name would smell as sweet.*
c. *A prion by any other name would evolve as sweet.*
d. *A donut by any other name would taste as sweet.*
e. *A kiss by any other name would feel as sweet.*
f. *A millstone by any other name would sink as fast.*
g. *A spammer by any other name would still be scum.*

And there are 147 examples of the following:

(10) h. *A fart by any other name...*

Shakespeare's *The Tempest* is the source of this famous quote: *such stuff as dreams are made on.* I have taken the liberty to include in my count of 'complete' quotes the variation: *...are made of.* These two variations combined occur 19,100 times. Another 1240 versions occur with variations like those in (11)a–g:

(11) a. *such stuff as nightmares are made on*
b. *such stuff as genes are made on*
c. *such stuff as legends are made of*
d. *such stuff as laws are made on*
e. *such stuff as revolutions are made of*
f. *such dust as dreams are made of*
g.*such bacon as dreams are made on*

And an honorable mention goes to (11h):

(11) h. *such stuff as landfills are made of*

My next example, *my kingdom for a horse,* comes from *Richard III.* In addition to 16,200 examples without modification, are another 41,900 variations, including:

(12) a. *My kingdom for a two-button joystick.*
b. *My kingdom for a web-editing tool.*
c. *My kingdom for a hands-free headset.*
d. *My kingdom for a Corvette.*
e. *My kingdom for a cup holder.*
f. *My kingdom for a quote.*
g. *My kingdom for a good plumber.*

And, being a Mac user myself, I especially liked (although Firefox is very good and Safari is definitely improving):

(12) h. *My kingdom for a Mac browser that doesn't suck.*

Hamlet is the source of another common expression: *get thee to a nunnery.* In my count of 14,300 examples, I also included …*nunn'ry.* The number of variations (21,500) outnumbers the original expression by a ratio of roughly 3 to 2. They include:

(13) a. *Get thee to a doctor.*
b. *Get thee to a gynecologic oncologist.*
c. *Get thee to a shrink.*
d. *Get thee to a library.*
e. *Get thee to a bookstore.*
f. *Get thee to a comicbookery* [sic].
g. *Get thee to a synagogue.*
h. *Get thee to a monastery.*

Those who know me would understand why my personal favorite is:

(13) i. *Get thee to a punnery.*

The most famous quotation from *Macbeth* is probably the incantation: *double, double, toil and trouble.* There are 13,400 occurrences of this string. There are another 674 examples of what I consider a misquote: *bubble, bubble, toil and trouble.* And there are another 1540 examples of purposeful variations, including:

(14) a. *Double, double oil and trouble*
b. *Double, double toll and trouble*
c. *Double, double heat and trouble*
d. *Double, double war and trouble*
e. *Double, double strife and trouble*
f. *Double, double boil and trouble*
g. *Double, double fowl and trouble*
h. *Double, double boils and trouble*
i. *Double, double donuts and trouble*

From the play *Julius Caesar* comes the famous quote *Friends, Romans, countrymen; lend me your ears.* The original form occurs only 6740 times; nevertheless there are over 24,000 variations, including:

(15) a. *Friends Democrats countrymen, lend me your ears. I come not to praise Wellstone but to endorse Mondale.*
b. *Friends Republicans countrymen, lend me your ears. I come to bury Clinton not praise him.*
c. *Friends, Romans, countrymen, lend me your ear muffs.*—James Thurber

d. *Friends, Romans, countrymen, lend me your beers.*
e. *Friends, Romans, countrymen, lend me your years.*
(15) f. *Friends, Romans, countrymen, lend me your fears.*
g. *Friends, Romans, countrymen, lend me your eels.*
h. *Friends, Romans, countrymen, lend me your money.*
i. *Friends, Romans, countrymen, lend me your eyes.*
j. *Friends, Romans, countrymen, lend me your earrings.*
k. *Friends, Romans, countrymen, lend me your shoes.*
l. *Friends, morons, countrymen, lend me your jeers.*
m. *People of Britain, lend me your arrears.*

And the one example that stood out most in my mind was (15)n:

(15) n. *Friends, Romans, countrymen, lend me your testicles.*

From *The Taming of the Shrew* comes another expression that most people would not attribute to Shakespeare: *not budge an inch,* which occurs 5060 times. Over nine times that number, 46,900, of variations occur. One variation, *not budge a foot,* occurs in another Shakespeare play, *Henry IV.* Some other variations from lesser contributors include:

(16) a. *not give an inch*
b. *not move an inch*
c. *not relinquish an inch*
d. *not advance an inch*
e. *not surrender an inch*
f. *not move NATO an inch*

And, not surprisingly, the metric version also appears:

(16) g. *not budge a centimeter*

The final example I will give, though this certainly does not exhaust the list, is from *Twelfth Night*: *Some are born great, some achieve greatness, and some have greatness thrust upon 'em.* Though not as frequent as the other examples (4610 originals and 412 variants), it is interesting because of the two forms; first the adjective *great,* then two occurrences of the noun form *greatness.* Some of the variants include:

(17) a. *...born mediocre ... mediocrity ... mediocrity*
b. *...born chumps ... chumpdom ... chumpdom*
c. *...born to suckiness ... suckiness ... suckiness*
d. *...born rural ... rural ... rural*
e. *...born fresh ... freshness ... freshness*
f. *...born gay ... gayness... gayness*

Play	Phrase
Hamlet	in my mind's eye
Taming of the Shrew	not budge an inch
Cymboline	not slept one wink
As You Like It	forever and a day
Richard III	off with his head
Macbeth	milk of human kindness

Table 1. *Common expressions taken from Shakespeare.*

g. *...born bisexual ... bisexuality ... bisexuality*

The version I must admit I most relate to is:

(17) f. *...born geeks ... geekness ... geekness*

As I previously mentioned, some expressions have become so common that they are no longer thought of as having been penned by Shakespeare. **Table 1** gives some of these examples.

The next two tables show that whatever the reason is for expressions to be modified, there seems to be no correlation between frequency of occurrence of use and percentage of the total occurrences that are modified in some way. **Table 2** (overleaf) summarizes the frequencies of use of the expressions I have been discussing and some others as well.

Table 3 (overleaf) gives the percentage of examples that appear in modified form. Note the lack of correlation between the frequency of occurrence and the percentage of examples which have been modified.

It must remain as future research to determine the factors, if there are any other than randomness, that determine which expressions are most likely to be used in modified form.

This paper has thus far been little more than a collection of some data compiled from the World Wide Web. However, one can adduce a number of things from this compilation.

My first and foremost conclusion has to be that I have convinced at least myself that Shakespeare remains to this day an incredibly great influence on relevant to modern, everyday language. I suspect that this influence is greater than that of any other source, with the probable exception of the Bible.

Of course, Shakespeare has not only been an important influence on the language, but on literature as well. One may well find the plots essentially the same as those found in other literature, but, of course, the reason is that the other literature has copied Shakespeare.

A second point I wish to make is to point out that one way to measure the influence of literature on modern culture is to plot its influence on society as a whole. To a large extent this influence will be mirrored in the content of the World Wide Web.

Third, Shakespeare to this day remains a very popular course in many universities. But one way to motivate geeks like me might be to have them explore the effect of Shakespeare on the modern day Web as I have done in this paper.

Phrase	Occurrences
to be or not to be	818,000
forever and a day	131,000
All the world's a stage.	127,000
To thine own self be true.	63,400
Alas poor Yorick	61,100
All that glitters is not gold.	33,000
Beware the Ides of March.	24,900
Brevity is the soul of wit.	23,700
Parting is such sweet sorrow.	20,900
compare thee to a summer's day	20,000
A rose by any other name would smell as sweet.	19,400
such stuff as dreams are made on	19,100
my kingdom for a horse	16,200
Neither a borrower nor a lender be.	15,100
Get thee to a nunnery.	14,300
Double, double, toil and trouble, cauldron…	13,400
Romeo, Romeo, wherefore art thou, O Romeo?	12,900
What a piece of work is man.	11,300

Table 2. *Common Shakespeare phrases and their frequency in Google searches.*

Play	Phrase	% modified
Taming of the Shrew	not budge an inch	94%
Romeo	Romeo, Romeo, wherefore art thou…	85%
Caesar	Friends Romans countrymen, lend me your ears.	79%
Hamlet	Alas, poor Yorick	75%
Richard III	My kingdom for a horse.	72%
Hamlet	Get thee to a nunnery.	60%
Hamlet	something rotten in the state of Denmark	56%
Hamlet	What a piece of work is man.	53%
Hamlet	to be or not to be	47%

Table 3. *Percentage of common phrases appearing in modified form.*

Finally, I see the data presented here as additional evidence for the notion that language use does not necessarily consist of building up clauses from words through generations of syntactic trees. This evidence strongly suggests to me that much of language consists of a process in which native speakers often express themselves by starting with complete expressions and making substitutions to fit the situation.

This is similar to how I envision the way schema work. The prototypical example of a schema is the Restaurant Schema. We know how to behave when we eat at a restaurant because we have a complex set of rules of behavior that we have learned through experience. We know to wait at the door for someone to seat us. We expect to be handed a menu. And so on. However, in each situation we must adjust our schema to fit the circumstances of the particular restaurant we are in at the moment. As I see it, this is very similar to having stored large numbers of complete sentence frames and choosing a given frame to express a given communication goal. Particular frames usually don't convey the exact message, so we modify the frame just as we modify our behavior to suit each new restaurant. Psycholinguistic evidence suggests that schema seem to be contained mostly in the right side of the brain, while language frames seem to be mostly in the right half. Nevertheless, the similarity suggests to me that the process is not all that different, albeit the two sides of the brain are working on different types of behavior.

The more evidence I collect of this substitution within large language units, the more I wonder: do people ever build clauses from scratch?!

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TIME-LINEAR ANALYSIS AND LINGUISTIC EXPLANATION

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THOUGH CALLING ITSELF LINGUISTICS, the modern discipline whose prime object of study is language has really been engaged in a form of metalinguistics. The reason for this observation is quite simple: virtually all statements in 'linguistics' about the structure of language are presented in terms of formal or semi-formal rules, be they transformations of deep structures, phrase structure rules, rewrite rules or other algebraic recombinatorics. These abstract rules, in turn, operate on two basic conditions: a) they require a human processor to interpret or comprehend them and b) they are based on abstract categories or parts of speech derived in large part from earlier approaches to language. Hence, much of the effort of linguistics has concentrated on generating abstract structures upon which actual utterances can then be mapped, if so desired. To cite Chomsky:

> A genuine theory of language has to satisfy two conditions: 'descriptive adequacy' and 'explanatory adequacy'. The grammar of a particular language satisfies the condition of descriptive adequacy insomuch as it gives a full and accurate account of the properties of the language, of what the speaker of the language knows. To satisfy the condition of explanatory adequacy, a theory of language must show how each particular language can be derived from a uniform initial state under the 'boundary conditions' set by experience. (2000:7)

This approach to explanatory adequacy rests on an articulated theory of Universal Grammar, and, in particular, a detailed theory of the principles and parameters that characterize the initial state of the language faculty. This focus on the competence versus performance distinction has led to a situation where analyses whose focus is on capturing and representing what is actually happening during natural language processing while it is happening have been largely ignored in theoretical linguistics. Such real-time or *time-linear* approaches would be more concrete and closer to language as actually instanced. However, adopting such a perspective would require a refocusing of linguistics from metalinguistic considerations to considerations focused on *languaging*, as I call the act of actually processing language in real time. This paper describes a number of problems and a few results which such a refocusing entails. Following some necessary preliminary definitions, a simple example will be developed with a view of generating a detailed, but, given space constraints, necessarily incomplete, description of the example that should meet modern scientific criteria pertaining to basic units, processes and representation. A few additional remarks can be found in the conclusion.

1. LANGUAGE: THE FUNDAMENTAL OBJECT OF LINGUISTICS. There are numerous definitions of language in the literature and there are probably even more views on the nature and function of language. In this paper, language is viewed as existing primarily to process information deemed relevant by human communicators. More specifically, language was developed in order to enable us to send, receive, store, access and manipulate information, whether that information be a silent internal monologue, a conversation within ourselves, a text which may even transcend cultures and centuries, etc. From this perspective, linguistics becomes the study of natural language viewed primarily as a tool for sending and receiving information rather than a bare algebraic study of forms that can be developed to represent the results of languaging activity. This immediately leads to a number of possibilities, not all of which can be addressed here. This paper focuses on the following problems: 1) information: its definition and representation; 2) the basic dynamics underlying receiving, processing and interpreting information as it is actually being received and processed. As will become evident, this approach leads to a set of research questions different from those currently being studied in most phrase-structural approaches, such as Minimalism. It also leads to a need to reconsider a reorganization of grammatical layers because the traditional and not-so-traditional fields of morphology and syntax lose their primary status while the lexicon takes on surprising proportions simply because it lies at the very heart of languaging. One could say that the lexicon is the very engine of languaging.

Recently, there has been a growing interest in the concept of time-linear procedural grammars that model knowledge of language from a moment-by-moment, functionalist, usage-based perspective: Dynamic Syntax (Kempson, Meyer-Viol & Gabbay 2001), Left Associative Grammar (Hausser 1999), Markov Grammar (Tugwell 1998), Axiomatic Grammar (Milward 1994), Linearized Phrase Structure Grammar (Shin 1987) and Discourse Information Grammar (Sévigny 2002a, 2002b, 2003, In Press). What distinguishes all of these approaches from the phrase-structural tradition used in most varieties of generative grammar is the underlying and guiding metaphor. Phrase-structure grammars are based on the metaphor that natural languages are formal languages and that there exists an autonomous syntactic module (largely) independent of semantics. In contrast, the time-linear approaches see a grammar of a language as a series of procedures permitting humans to construct partial representations as a sentence is being processed and understood or (re)-constructed. Thus, knowledge of language is knowledge of the processes and information necessary to understand and use the language. In the words of Tomasello:

> …many linguists and psychologists believe that there is a biological basis for language, just not in the form of an autonomous Generative Grammar. Just as plausible for these linguists is the hypothesis that language rests on more general biological predispositions, such as the abilities to create and learn symbols, to form concepts and categories, to process information rapidly, and to interact and communicate with other persons intersubjectively. (1998:xi)

2. LANGUAGING. In order to capture languaging on the fly, we need to adopt a linear, incremental approach. We also need a systematic and consistent way of capturing information

as it is being received. In this paper, we will forego very real complexities involved in isolating words phonetically and treat the problem as solved, since its actual solution is unlikely to affect any of the results we describe. Though the approach sketched in this paper may appear to be concerned merely with printed words, tackling phonetic reality is at the core of our research. For the present, phonological considerations remain an area of active research and beyond the scope of this short paper. Linear information accumulation as generated by the process of languaging requires that we address several immediate problems:

a) what is the nature of the information coming in?
b) how can it be captured?
c) how does it build up?
d) how can it be represented efficiently and meaningfully?
e) how do communicators keep up with it?

2.1. DISCOURSE INFORMATION GRAMMAR. The approach used in this paper is called Discourse Information Grammar, or DIG for short (see Sévigny 2002a, 2003, 2004 for details). Essentially, DIG describes information as it is built up during natural language processing, here called languaging. DIG has developed a rich definition of information which unfolds unevenly along several parallel axes as information flows in, word by word. First, a new word is treated as an incoming token. This is matched against the speaker's mental lexicon and if a match is found, the token is lexicalized and becomes a word. This process of lexicalization simulates word recognition. Often, we hear a word but temporarily fail to recognize it. Until we do recognize it, there is no meaning associated with it. Such a situation can even become annoying enough to prompt us to ask what is being referred to in the conversation. In reading, we often run into a new word and look it up in a dictionary, especially if the word is critical to comprehension. In terms of DIG parlance, when we look up a new word we lexicalize it and, if necessary, add it to our mental lexicon.

One of the major claims of DIG is that there is much more to sentence processing than assembling atomic units into rigid patterns. Consequently, in DIG words are not treated as atomic nuclei or lego pieces that are processed and assembled into rigid utterance patterns. Rather, a word is more akin to a flexible lego piece, to maintain the metaphor, which carries a certain range of possibilities. Context gradually constrains its final contextual informational contribution. A major consequence of this approach then, requires that the concept of information be looked at very closely when it comes to tackling the multiple processes involved in accumulating information during languaging.

As noted above, in DIG the lexicon plays a central role. In order to capture lexical or stored information, DIG uses a number of lexical templates covering the traditional parts of speech, as well as such less traditional additions as adjuncts, even including structure type schemas. These schemas are actually complex feature structures, most of which consist of binary-valued fields. Just how the mind stores these feature complexes remains an area of intensive research and here DIG's contribution must content itself with pointing out that more is involved than merely concatenating words into utterances. Once we

understand what it is we are trying to capture, then we will be in a better situation to tackle the complexities which phonology entails.

By default, lexical features are normally underspecified initially and become specified as soon as it is possible to do so. For instance, the definite article *the* is initially unmarked for number, but if an utterance continues with *dogs*, then the feature NUMBER becomes specified to [+plural]. Again, the nominal phrase *dogs with big teeth* is initially unmarked for functional role. But in the case of *Dogs with big teeth appeared …* the functional role is specified to SUBJECT, while in the case of *Dogs with big teeth, I don't like* is specified as TOPIC and eventually DIRECT OBJECT. It should be noted here that in addition to lexical information, DIG also uses, among other parameters, functional roles, structure type, logic type, local context, discourse unit, TOPIC chain, and semantic field. (Definition of these parameters would take us beyond the scope of this paper, but see Sévigny 2002a for details.) As information accumulates, each of these information streams is integrated through specification of one or more of its field values or becomes activated because information accumulation to date has made a new structure possible. Combined, these feature specifications result in what DIG refers to as information situations. See the example below for a simple illustration. Use is also made of world knowledge and commonsense knowledge. Information situations are generated as soon as it is possible to specify at least some of their required fields. Information accumulation occurs automatically and is not dependent on deus ex machina mechanisms. For instance, if one were to process the utterance *he grabbed the white cat and caved his assailant's HEAD in with it*, one would initially register puzzlement because it is very difficult to cave anyone's HEAD in with a cat, regardless of its colour. If an earlier context had identified the *white cat* as a metal statue then there would follow a change of certain feature specifications attached to the nominal phrase *the white cat* from [+animate], [+soft], etc. to [-animate], [+metal], [+hard], etc., and the information carried by the utterance would regain consistency. This example illustrates, in part, how DIG deals with metaphor.

In order to maintain control over so many operations taking place in parallel, DIG has developed several processes which enable speakers to keep up with this steady flow of information. For instance, anticipation based on overlearned patterns is used to prespecify anticipated development. Overlearned patterns make heavy use of phrase-structure grammar but with a variation (Tomasello 2003:6). Children (or anyone else, for that matter) are exposed to tens of thousands of hours of languaging experience with a tremendous amount of repetition occurring in structural patterns, in information situation types, in functional roles (and their resolution). After a while, these become fixed in long-term memory and can be accessed much more quickly. Since they occur with great frequency, they act as moulds and it is these overlearned, highly fixed patterns of structure which enable us to anticipate what is likely to come next (Hawkins 2004). Not that it always turns out as anticipated, of course. Also, when too many new or unknown patterns start occurring, communication slows down to a crawl until these new patterns become integrated as speech habits.

DIG also uses a small number of processes in addition to lexicalization, including concatenation, integration, closure, discourse-level monitoring. Sévigny 2000 describes eleven of these processes. They seem to cover the fundamental needs for natural language processing.

Each of these processes operates in terms of specifications and unifications made on the binary-valued features of the lexical entries which are being or have been processed. Eventually, a text or utterance comes to an end. At this point, everything which can be specified is specified. The resulting network of information connections established becomes the base for a formal description and assessment of just what information has been accumulated. It is this accumulated information network which simulates interpretation and comprehension. A few additional remarks can be found in the conclusion. We now turn to an illustrative example which includes additional discussion.

3. A WORKED EXAMPLE. We now process the simple text in (1).

(1) The hungry cat caught a fat mouse.

It would have been more realistic to have presented (1) word by word, since that is how we actually perceive it. However, a little use of the imagination will enable us to simulate reality. Before we begin let us anticipate a possible objection: namely, a good reader merely glances at (1), takes it all in and then actually processes it. That could be so, but in practice we could stretch (1) as if it were spoken very slowly, one word at a time, and assembled in a manner analogous to what will be described shortly. Also, it is quite possible to simulate this slow speech by putting only one word on a page and processing the information received before turning to the next page. It could even be a hidden word in the text of the next page, for example. It is quite possible, in fact, that we did something like this very slow processing when we were learning our first language. Then, with experience, we learned and stored certain patterns, etc. Following are a few typical lexical entries. First, a typical noun entry in (2), a typical pronoun entry in (3), the definite article in English in (4), and a typical verb entry in (5).

(2) NAME:< >
CATEGORY: noun: common
STRUCTURE-TYPE: [nominal]
INDEX: gender [ ], number [ ], person [ ]
HEAD?:
F-ROLE:
SEM: {...}

(3) NAME: < >
CATEGORY: pronoun: personal
STRUCTURE-TYPE: [nominal]
INDEX: gender [ ], number [ ], person [ ]
HEAD?:
F-ROLE:
LINK:
SEM: {...}

(4) NAME: < the >
CATEGORY: article: definite
STRUCTURE-TYPE: [nominal structure]
INDEX: gender [ ], number [ ], person [ ]
SEM: {[+definite], …}

(5) NAME: < >
CATEGORY: verb
STRUCTURE-TYPE: [verbal]
INDEX: gender [ ], number [ ], person [ ]
F-ROLE:
ARGUMENT-STRUCTURE: ({n-1},{n-2}, {modifiers})
TIME:
SEM: {…}

Most of the fields in actual entries are unspecified. In some cases, specification is default or hard-wired as in the case of the French definite article *la*, which would have INDEX values of gender [+feminine], number [+singular] and person [+3]. Any of these prespecifications can be overridden, should it conflict with accumulated information. It is part and parcel of DIG that any specification can be altered if need be, but only in terms of localized contexts, since these are directly bound up with the information currently being accumulated. In the schemas for noun and pronoun, the CATEGORY is specified by default as nominal. This simulates the fact that we learn that nouns and pronouns belong to a certain category. This information is learned subconsciously and can be verified by observing children playing the game of making up an utterance by adding one admissible word at a time. They know whether, for example, *green* can be added to, say, *my big*. If they lacked structural knowledge, such judgments would not be possible. An analogous observation holds for adults who encounter an unusual word. (*I don't know what it is, but it's a …* or *I don't know exactly what it's doing but it's doing something, whatever that is*, etc.) Among many other features, it seems that humans are hard-wired to recognize and store category information such as *nominal structure type*, *verbal structure type*.

Inputing and lexicalizing *the* we accumulate the information in (4), repeated here as (6) for convenience.

(6) NAME: < the >
CATEGORY: article: definite
STRUCTURE-TYPE: [nominal structure]
INDEX: gender [ ], number [ ], person [ ]
SEM: {[+definite], …}

This yields the initiated nominal structure in (7), where the curly brackets stand for (6).

(7) the{}

So far, we only know that in all probability a nominal structure has been initiated. It will have the property of being a definite or specific nominal structure. We have no information pertaining to the structure's INDEX values, its semantic field, its functional role. By default, we assume that the logic type is assertive. We know nothing about its HEAD, although we anticipate that it is forthcoming. Whether there will be modification is still unknown.

We now receive *hungry*. After comparing it against our mental lexicon, we lexicalize it and obtain the information in (8).

(8) NAME: < hungry >
CATEGORY: modifier: adjective: descriptive
STRUCTURE-TYPE: [nominal]
INDEX: gender [ ], number [ ], person [ ]
SEM: {{need: food, must:eat(n-1[+animate}, n-2[+food], {modifier}}...}

This entry indicates that *hungry* belongs to a nominal structure, that it has a modality as part of its semantic feature set: a necessity to perform the process 'eat(n-1, n-2, {modifier})'}. The modality feature simulates the knowledge that in order to feel hunger one must be alive and that one must eat sooner or later. Also, if one is to eat, a second nominal structure must belong to the semantic category of food. Semantic schemas are currently a SUBJECT of intensive research. In this paper they will be assumed since their eventual specification will not alter the description being presented in any significant way. Note that in terms of our information accumulation, we still know nothing about the HEAD, the INDEX values, or the functional role of the nominal structure. DIG uses a special mechanism called TEMP to capture adjectival information. This is to simulate our ability to build up a long string of adjectives before attaching them to a noun as (9).

(9) It was a poor yet joy-filled, malodorous yet cherished old, ramshackle home

In such cases, the HEAD is slow to arrive, and yet the adjectives are piling up. TEMP holds the temporary set of semantic features that are accumulated until the HEAD arrives. At such a time, the values accumulated in TEMP are attached to the HEAD through the process of feature unification. TEMP is emptied and the nominal which has been designated the HEAD acquires the values taken from TEMP as part of its own semantic feature set. Thus, in DIG *the* + *hungry* is not a fixed word of some sort such as **thehungry*, preventing further processing, but an initialized incomplete nominal phrase still awaiting its HEAD. Because of the unpredictability of semantic features, the feature SEM{...} is open, and necessarily so. In this example so far, TEMP has acquired the information in (10).

(10) TEMP:
NAME: < the, hungry >
CATEGORY: modifier: 1. the: definite article
2. hungry: adjective: descriptive
STRUCTURE-TYPE: [nominal]

INDEX: gender [ ], number [ ], person [ ]
SEM: {[+definite], {need: food, must:eat(n-1[+animate], n-2[+food], {modifier}}...}

So far, our information accumulation is still modest:

(11) the{} + hungry{}

where the '+' symbolizes the process of concatenation which occurs within a structure. Connecting different structures is called **integration** and is symbolized with ⊕. Next, we process *cat* and obtain (12).

(12) NAME:< cat >
CATEGORY: common noun
STRUCTURE-TYPE: [nominal]
INDEX: gender [ ], number [+singular], person [+3rd]
HEAD?: +
SEM: {[+definite], {{need: food, must:eat(n-1[+animate], n-2[+food], {modifier}, [+animal], [+animate], [+feline]...}

At this stage, we can effect further specifications, e.g. that *cat* is the HEAD of the nominal structure being built up. We still do not know what its functional role will be, but since it is the first nominal structure and since there is a reference to 'eating' the nominal whose HEAD is cat is likely to be assigned the functional role of SUBJECT. Still, it could be assigned the role of TOPIC. It could even be the beginning of a compound SUBJECT. We cannot decide until we come to the end of the structure or the utterance fragment. Thus, we continue and process *caught*. This is a verb. Its structure type is verbal and its lexical entry form looks like (13).

(13) NAME:< caught >
CATEGORY: verb:transitive
STRUCTURE-TYPE: [verbal]
INDEX: gender [ ], number [ ], person [ ]
F-ROLE: PREDICATE
ARGUMENT-STRUCTURE:(n-1, n-2, {modifiers})
TIME: [+past], [+complete]
SEM: {{catch (n-1[+animate], n-2[ ], {modifier},)}}

Since the nominal structure has come to an end, it is closed (indicated by '#') and acquires the functional role set applicable to nominal structures. This is the complete range of functional roles nominal structures can assume. There are about a dozen or so of these roles {SUBJECT, direct object, indirect object, object of a preposition/postposition, TOPIC, subjective completion, ...} which commonly occur in modern English. The functional role assignment process sets in. Several comparisons are made to see if its semantic feature

values are compatible with the requirements of n-1 in '(catch(n-1[+animate], n-2, {modifiers})'. Given that there is compatibility between the feature values of *cat* and the feature value requirements of argument n-1 of 'catch(n-1, n-2, {modifiers}', nominal structure-1 *the hungry cat* is substituted for n-1, which assumes all of the feature structure, including any specifications, of *the hungry cat*. The functional role SUBJECT is assigned to *the hungry cat* since there is no pause (usually expressed as a comma in writing) to mark it as a possible TOPIC. At this point, something else also happens: a localized context has been established and results in an information situation which can be schematized as in (14).

(14) Situation:

Event: catch(n1[+animate], n2 = ?, {complement} = ?): [+process]

Doer: n1 = < the hungry CAT$_{\text{HEAD}}$ >
NAME: <cat>
CATEGORY: common noun: concrete
STRUCTURE-TYPE: nominal-structure
HEAD?: +
INDEX: gender [ ], number [+sg], person [+3rd]
SEM: {[+definite], {{must:eat(n-1[+animate], n-2[+food],
{modifier}, [+animal], [+animate], [+feline]...}

Object: n2 = ?

Complement: = ?

Continuing in this manner, we process *a fat mouse* and arrive at the final status in (15).

(15) Situation:

Event: catch(n1[+animate], n2 = ?, {complement} = ?)

Doer: n1 = < the hungry CAT$_{\text{HEAD}}$ >
NAME: <cat>
CATEGORY: common noun: concrete
STRUCTURE-TYPE: nominal-structure
HEAD?: +
INDEX: gender [ ], number [+sg], person [+3rd]
SEM: {[+definite], {{must:eat(n-1[+animate], n-2[+food],
{modifier}} [+animal], [+animate], [+feline]...}

Direct Object: n2 = < a fat MOUSE$_{\text{HEAD}}$ >
NAME: < mouse >
CATEGORY: common noun: concrete
STRUCTURE-TYPE: nominal-structure
HEAD?: +

(15) INDEX: gender [ ], number [+sg], person [+3rd]
SEM: {[-definite], [+animal], [+animate], [+feline], [+edible], [weight > mouse-average…}
Complement = Ø

4. REPRESENTATION. What is the best way of representing the information accumulated during natural language processing? Trees are fine for capturing constituent structures but create non-linguistic problems when applied to capturing an entire sentence. Given that information situations require certain specifications before they are triggered or generated, they seem to lend themselves to something akin to Petri nets (Reisig 1985) or relational networks (Lamb 1999). Also, given that specification occurs unevenly and across the entire gamut of information streams, including changes whenever necessary, using strict mono-linear representation schemas again creates non-linguistic problems. Networks seem better suited to capturing this type of information since they can be easily adapted to Petri net conditions. Of course, should this representational avenue prove promising, Petri net conditions would become a tool, not the goal for yet another metalinguistic approach (Reich & Richards, in press). Being non-linear representation schemas, networks also lend themselves to representing delayed specifications and links, including anaphoric links, as soon as specification becomes possible. Complicated movement rules, rewrite rules and so forth are not necessary, since connections can be made via edges from one node to another, once the connection becomes specifiable.

Another way of capturing 'languaging' information lies in the domain of orchestral scores where many streams of notation run in parallel with each stream devoted to an instrument or a section. Initially, DIG was developed using a variation of this sort of notation, where different streams of information played roles analogous to different instruments in an orchestra. This lent itself quite nicely, but required an efficient way of printing horizontally. However, this is just a technical detail and 'flipping' the representation ninety degrees results in a 'score' which is read vertically rather than horizontally. In this manner, it is possible to represent information accumulation and read its interpretation quite readily. Finally, by registering what has become established and specified in tables of binary values, it is possible to create (temporary) states of information accumulation using variations of transition tables to capture and represent information-state tables. From these, all the accumulated information can be stored and/or accessed quite economically.

5. CONCLUSION. Assuming that we have DIGed a text, what have we actually accomplished? To begin with, we have achieved a realistic description of what has actually transpired during the processing of that text as it was transpiring. At any point, we can (stop and) generate a snapshot of the information accumulated up to the point of that snapshot by using the mechanism of information-state tables referred to above. And there is no need to terminate early because of incompletion, as in the case of fragments. Not only that, but the snapshot can also contain anticipations which simulates our reaction to questions like what has been said so far and what will probably come next.

When we have completed a text, we are in a position to answer a large number of questions concerning the structure and content of the text. We have also produced a series of very specific representations of the information which was gradually accumulated during the processing of the text. These can be recorded using appropriate binary-valued registry-like tables. These tables enable us to traverse snapshots of information states somewhat like state transition chart traversals. Thus, we can produce pictures of information as it is being built up. Moreover, given that we are dealing with binary-valued specifications, it becomes possible to set up experiments which will measure just how much and what type of information has been accumulated. We are also in the position of dealing with metalinguistic questions concerning details of structure, statistics. What is more, by reversing the process, we can become the senders of information in a way which simulates encoding of information, though this will require a different set of planning strategies. This stage is still a research objective, but preliminary results are very promising. It becomes clear, moreover, that lexical information as well as structural information, with a default or updated value setting for logical type information (for example, initially [+assertive], which may be altered to, say, [+interrogative], should such a change be required), and semantic feature compatibilities all need to combine to produce information in a way similar to how humans produce and transmit such information Such an approach depends on developing the lexicon and formulating goals in terms of logic and functional roles. This approach lends itself to intelligent systems and cognitive neuroscientific exploitation, since experiments can be set up which can be verified, repeated, and made increasingly more precise by adding new fields or modifying existing ones.

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THE DEMONSTRATIVE DETERMINER *NEI* AND REGISTER VARIATION: A COMPARISON OF CONVERSATIONS AND NEWS BROADCASTS IN CHINESE

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THE PURPOSE OF THIS PAPER[1] is to compare uniquely identifiable noun phrases (NPs) in interactive conversations vs. news broadcasts in Chinese. More specifically, this study compares the use of the demonstrative determiner *nei* in conversation vs. the bare/zero determiner in news broadcasts in introducing a uniquely identifiable entity. Shi (2002) suggests that the use of *nei* in Chinese referring expressions is genre-dependent; that is, *nei* NPs occur most frequently in interactive conversations, less frequently in written narratives, and hardly at all in news broadcasts, as is shown in **Table 1** (overleaf):

However, Shi (2002) does not focus on the form and its register variations, although the above data were recorded according to eight different genres. In the present follow-up study, I focus on the distribution of *nei* in two genres, face-to-face conversations vs. news broadcasts, and examine their register variations (see Biber 1986, Biber & Conrad 2001) in terms of the use and nonuse of *nei* in encoding first-mention definite entities. I use the notions of 'uniquely identifiable' (Gundel et al. 1993), 'inferrable' and 'containing inferrable' (Prince 1981, 1992), and 'P-sets' or 'association set' (Hawkins 1978, 1991) to analyze the required conditions that *nei* may meet to qualify as a first-mention definite marker. I argue that the Chinese definite marker *nei* has not been grammaticalized. Compared with other languages (see Diessel 1999, Heine 1997), the Chinese language is at an early stage of a developmental process whereby the distal demonstrative *nei* 'that' is starting to behave like the definite article *the* (Li and Thompson 1981:131–32), and bare NPs are the major, unmarked linguistic forms in encoding referents. Nevertheless, I demonstrate that *nei* has shifted from being a pure distal demonstrative into a definite marker, and I provide empirical evidence for such a change in progress (also see Laury 1997 for Finnish *se* as an emerging definite marker). I explain why the appearances of *nei* as a definite article occur initially in interactive, face-to-face conversational discourse rather than news broadcasts, exploring factors such as the interactive nature of conversation, shared knowledge, and the salience of the conversation topics. I also point out examples where *nei* is used to encode definite generic reference.

1. THEORETICAL NOTIONS USED TO DEFINE NEI NPS AS FIRST-MENTION DEFINITE ENTITIES. When Li and Thompson (1981:131–32) claim that 'the demonstrative *nèi* 'that', however, is beginning to function as 'the' if it is not stressed', they base their claim on the evidence that *nei* is used to refer to a previously-mentioned entity in the discourse and thus an activated entity (Gundel et al. 1993) or an evoked entity (Prince 1992). If, during the developmental

Text type	Words examined	*Nei* NPs	'Unique' *nei* NPs
Conversation	10,000	143	47
Newscast	8,000	0	0
Formal speech	6,000	0	0
Letter	10,000	8	4
Fiction	10,000	49	22
Magazine (people)	8,000	5	2
Magazine (things)	8,000	16	8
Academic writing	8,000	1	0
Total	68,000	222	83

Table 1. *Distribution of uniquely identifiable* nei *NPs in texts (Shi 2002:89).*

In Focus	Activated	Familiar	Uniquely Identifiable	Referential	Type Identifiable
Ø *tā* 's/he, it'	*TA* *zhè* 'this' *nèi* 'that' *zhè* N		*nèi* N		*yi* N 'a N' Ø N
it	*HE, this, that, this* N	*that* N	*the* N	indefinite *this* N	*a* N

Table 2. *Linguistic forms and highest required status (Gundel et al. 1993:284).*

stage, *nei* can encode an activated entity, the next question in tracing its development into a definite article is whether *nei* can also encode a first-mention definite entity that the speaker believes the listener can uniquely identify based on all the information that the NP contains. If so, the development seems to be one step further in the process.

To repeat: in this study, I employ three theoretical notions to analyze the use of first-mention definite *nei* NPs, that is uniquely identifiable (Gundel et al. 1993), inferrable and containing inferrable (Prince 1981, 1992), and P-sets or association sets (Hawkins 1973, 1991).

Gundel et al. (1993) examine Chinese referring expressions briefly as an initial test for the universality of the Givenness Hierarchy (see **Table 2**). 'Forms are listed below the highest cognitive status necessary for their appropriate use' (Gundel et al. 1993:283).

According to the correlation in **Table 2**, the demonstrative determiner *nei* requires that the referent be at least uniquely identifiable. The referent of a *nei* NP does not have to be familiar, as in the case of English *that*, in order for *nei* to be used. However, because their data sample was so small, they did not find any occurrences of uniquely identifiable *nei* NPs. More work has been carried out subsequently and has shown empirical examples of *nei* NPs to encode uniquely identifiable entities (see Shi 2002). This empirical finding is important in that it traces stages and spreading of the article use system. Many languages have gone through similar processes. For example, according to Laury's (1997) study, during the

last one hundred years there has emerged the use of a developing article from the demonstrative *se* in spoken Finnish, first to encode prominent, cognitively accessible referents during the beginning period covered in the study, and then, to encode identifiable referents in the current, modern period. Thus, the use of *se* has spread over the last hundred years.

In Gundel et al. (1993) UNIQUELY IDENTIFIABLE is defined in the Givenness Hierarchy as a cognitive status of the addressee who can identify the speaker's intended referent on the basis of the nominal alone. This status is a necessary condition for all definite reference and is necessary and sufficient for the appropriate use of the definite article *the*. Consider their example:

(1) I couldn't sleep last night. The dog (next door) kept me awake.

The dog (next door) is assumed to be uniquely identifiable in the listener's interpretation of the phrase and therefore *the* is used to refer to this first-mention definite entity.

Prince defines the notion of INFERRABLES as part of her Taxonomy of Assumed Familiarity: 'A discourse entity is Inferrable if the speaker assumes the hearer can infer it, via logical—or, more commonly, plausible—reasoning, from discourse entities already Evoked or from other Inferrables' (Prince 1981:236, see also Prince 1992). For example:

(2) I went to the post office and **the stupid clerk** couldn't find a stamp. (Prince 1981:237)

In (2), *the stupid clerk* is Inferrable from the common knowledge that the post office has clerks. Prince explains CONTAINING INFERRABLES as discourse entities that are inferrable from what is contained within the Inferrable NP itself. The difference between Inferrables and Containing Inferrables is that 'the entity which triggers the inference is not, as in the case of the Inferrables, necessarily in the prior discourse, but is rather *within the NP itself*' (Prince 1992:307), as in (3):

(3) **The door of the Bastille** was painted purple. (Prince 1992:307)

The door can be inferred based on the information contained within the NP itself; that is, *the Bastille* within the Inferrable NP triggers the inference 'that a building like the Bastille typically has a door' (Prince 1992:308).

Similarly, Hawkins (1991:408) argues that 'the parameters of uniqueness may also be defined on the basis of a more general kind of knowledge of associative relationships between entities.' Moreover, the unique referent of a first-mention definite NP exists and is located within a relevant set. Thus, the mention of a class triggers a whole set of associations for the addressee and makes it perfectly legitimate to use a first-mention *the* NP as in *the professor, the textbook, the final exam*, to refer to items in the association set of a course.

> The membership of an entity within such an 'association set' is determined by general community knowledge involving predictable, or functionally acceptable,

co-occurrences of entities, and uniqueness is definable relative to each set. (Hawkins 1991:409)

The following example illustrates Hawkins' point:

(4) We'd been down the 'scary' route the previous year, one of those rare times when Mom had bought us costumes. Mine was *a devil's outfit* made of cheesecloth. *The tail* was too long, and I stepped on it as I ran to look in the mirror. The tail had torn partially away, showing my underwear. *The material* was too flimsy for Mom to sew shut, so she closed it with tape. (*Reader's Digest*, vol. 10 [1996]:38)

These three theoretical notions are used to study the first-mention definite *nei* NPs in the following discussion.

2. DATA. The face-to-face conversation data for this study are drawn from the China Central Television Channel 4 (CCTV-4) program, 实话实说, *shi hua shishuo* 'say what you believe is true' from Beijing, China. It is similar to an American talk show, involving a host/hostess, several guest speakers, and an audience, engaging in direct conversation on a particular topic of human experience. I collected transcripts of ten episodes. Approximately 170 transcribed pages have been studied. The data for news broadcasts are from 新闻联播, *xinwen lianpo* 'news network' from China Central Television Channel 4 as well. Four days of news were randomly selected.[2] Each day contains twenty-one items of domestic and overseas news, amounting to approximately one hundred pages of transcribed text.

3. THE DISTRIBUTION OF NEI NPS IN CONVERSATION AND NEWS BROADCASTS. All NPs with the demonstrative determiner *nei* are examined and put into one of four categories: situational, activated (contrastive), activated (noncontrastive), and uniquely identifiable. 'Situational reference' (Biber et al. 1999) identifies entities whose interpretation of definiteness depends on extralinguistic factors such as pointing gestures, the context within the conversation scope and the larger context that the speaker and the hearer share in the universe, such as a community where the speaker and the hearer can identify *the townhouse, the post office, the nature center*, etc. 'Activated' (Gundel et al. 1993) refers to things mentioned in the previous discourse text. If the function of a following mention with the determiner *nei* is to contrast or emphasize a referent, it then has a strong demonstrative function; if, on the other hand, *nei* is used to refer to a previously mentioned noncontrastive entity, it has then lost its demonstrative function. Finally, 'uniquely identifiable' (Gundel et al. 1993) refers to all *nei* NPs that are assumed to be identifiable through association sets, inference, or even the descriptive nominal itself. See **Table 3** for the distribution of *nei* NPs in conversation and news broadcasts under the four categories:

It is interesting to note that demonstrative determiner *nei* NPs occur only in conversational registers and seldom appear in news reporting. When *nei* introduces a situational referent (twelve instances in conversation) or a contrastive activated referent (nine instances in conversation), it carries all the properties of a true demonstrative determiner by actually

	Situational	Activated (Contrastive)	Activated (Noncontrastive)	Uniquely Identifiable
Conversations	12	9	43	55
News Reports	0	0	1	0

Table 3. *Distribution of demonstrative determiner* nei *NPs in conversation from* 实话实说 *'Say what you believe is true' vs. the news reports from* 新闻联播 *'News Network'.*

pointing to the referent. As Diessel points out, 'The grammaticalization of demonstratives is a continuous process leading from exophoric demonstratives used to orient the hearer in the outside world to grammatical items serving specific syntactic functions' (1998:118). This shift from a pure demonstrative to a definite marker is observed when *nei* is used simply to refer to a previously mentioned entity in discourse without contrasting or emphasizing the entity, and thus it becomes a deictically-neutral, definite marker. There are forty-three cases of such use in conversation. This supports the observation that *nei* is beginning to behave like a definite article. However, the distribution of *nei* in **Table 3** seems to suggest that its role as a definite article only appears in conversation as compared with news reports. The same is true of the category of uniquely identifiable with fifty-five instances of *nei* in conversation. This is the category that I focus on in this study, in that I assume that during its transition from a pure demonstrative to a deictically-neutral definite marker, *nei* would start by introducing an activated referent first and then go to the next step to introduce a uniquely identifiable entity in discourse, whose successful referential identifiability relies on inference based on shared knowledge or the information contained in the nominal itself. While linguists have studied *nei's* introduction of an activated referent, its role in encoding a first-mention, uniquely identifiable entity needs more attention, especially since such an occurrence is genre-dependent. Therefore, the investigation of *nei* as a uniquely identifiable definite marker in conversational context vs. news reports is the emphasis of this study. I now compare uniquely identifiable NPs in news reports and conversations.

In news broadcasts, I have found numerous uniquely identifiable NPs and, in fact, news reports are packed with uniquely identifiable entities whose identification is assumed on the basis of information contained in the long, complicated nominal itself. However, in news texts these uniquely identifiable NPs are encoded without *nei*. Consider (5):[3]

(5)

今年	全国	爱眼日的	主题	是	"预防
Jinnian	*quanguo*	*aiyanride*	*zhuti*	*shi*	*yufang*
this-year	whole-country	love-eye-day-ASSO	theme	is	prevent

近视,	珍爱	光明",	今天,	各地	围绕
jinshi,	*zhenai*	*guangming,*	*jintian,*	*gedi*	*weirao*
near-sightedness	appreciate	brightness,	today,	everywhere	around

这一主题	纷纷	举行了	宣传	咨询	和
zheyizhuti	*fenfen*	*juxingle*	*xuanchuan*	*zixun*	*he*
this-CL-theme	one-after-another	hold-PFV	disseminating	consulting	and

(5) 义诊 活动。
yizhen huodong.
volunteering-medical-service activity

'The theme of this year's National Eyes Appreciation Day is Preventing Nearsightedness and Appreciating Brightness. Today, people have started activities of disseminating, consulting and volunteering medical services around this theme.' (News Network, 6 June 2005)

The underlined NP *Jinnian quanguo aiyanride zhuti* 'the theme of this year's national Eyes Appreciation Day' follows the title, *National Eyes Appreciation Day: Preventing Nearsightedness and Appreciating Brightness*. It can be inferred that such an activity must have a theme, based on Prince's notion of Containing Inferrables. Thus, the hearer is able to identify the referent. The news then continues in (6):

(6) a. 第四次 全国 学生 体质健康 调研 结果 表明：
disici quanguo xuesheng tizhijiankang diaoyan jieguo biaoming:
the-fourth national student health investigation result show

近年来 学生 近视率 居高不下。 针对
jiannianla xuesheng jinshilü jugaobuxia. zhendui
recent-years student nearsightedness-rate rise-not-decrease regarding

这种情况， 各地 纷纷 b. 把 关注的 焦点
zhezhongqingkuang, gedi fenfen ba guanzhude jiaodian
this-kind-situation everywhere in-succession BA concern-ASSO focus

集中到 青少年 身上。 安徽， 河北， 江苏， 广西的
jizhongdao qingshaonian shenshang. anhui, hebei, jiangsu, guangxide
concentrate youngsters towards Anhui Hebei Jiangsu Guangxi-ASSO

医务 工作者… 为 孩子们 讲解 c. 正确的 读书写字
yiwu gongzuozhe… wei haizimen jiangjie zhengquede dushuxiezi
medical professionals for kids explain correct-ASSO read-write

姿势， 和 看电视 用电脑时的 用眼 卫生 知识。
zishi, he kandianshi yongdiandaoshide yongyan weisheng zhishi.
position and watch-TV use-computer-ASSO use-eye hygiene knowledge

'The results of the fourth national student health investigation show that in recent years the rate of student nearsightedness has gone up. In order to change this, people everywhere are starting to focus their attention on youngsters. The medical workers in Anhui, Hebei, Jiangsu, and Guangxi are beginning to explain to the youths correct reading and writing postures and knowledge of hygiene in watching TV and using a computer.' (News Network, 6 June 2005)

In (6), there are three uniquely identifiable NPs. NP (a) *disici quanguo xuesheng tizhijiankang diaoyan jieguo* 'the results of the fourth national student health investigation' presupposes that any investigation must have results, and, thus, the hearer can be expected to connect this particular result to the investigation of students' overall health. NP (b) *guanzhude jiaodian* 'the focus of concern' occurs in the BA construction, in which the direct object or the BA noun phrase is placed after the subject and before the verb. This BA noun phrase is generally definite or generic (Li & Thompson 1981:465). Again, the NP illustrates that when people start to show concern for something, they usually have a focus. In this NP, the focus can be identified by the hearer. Finally, NP (c) *zhengquede dushuxiezi zishi, he kandianshi yongdiandaoshide yongyan weisheng zhishi* 'correct reading and writing postures and knowledge of hygiene in watching TV and using a computer' itself contains enough descriptive information for the hearer to identify the entities upon hearing the NP. What examples (5) and (6) share is that their uniquely identifiable NPs are long and complicated with other NPs embedded in them, which is typical of the news register.

While the news register does not employ the demonstrative determiner *nei* for uniquely identifiable entities, in conversation such use emerges, as exemplified in (7), (8), and (9):

(7)

对，	去北京	电影学院	报名的	时候，	刚	一进	<u>那个</u>
dui,	*qu Beijing*	*dianyingxueyuan*	*baoming de*	*shihou,*	*gang*	*yijin*	*neige*
right,	go Beijing	Film-Academy	register-ASSO	moment	just	enter	that-CL

<u>地下室</u>，	就	看到	人山人海，	特别	吓人。
dixiashi,	*jiu*	*kandao*	*renshangrenhai,*	*tebie*	*xiaren*
basement	then	see	people-mountain-people-sea,	especially	scare-people

'Right. [We] went to the Beijing Film Academy to register, and as soon as [we] stepped into the (lit. that) basement, [we] saw tons of people there. [It was] very scary.' ('Kids' episode, page 5)

(8) …

你看	<u>我住的</u>	<u>那个</u>	<u>寨子</u>，	估计	我们	小的
nikan	*wozhude*	*neige*	*zhaizi*	*guji*	*women*	*xiaode*
you-see	I-live-NOM	that-CL	stockade-village	estimate	we	young-ASSO

时候	是	一个	寨子，	现在	是	四个	寨子，
shihou	*shi*	*yige*	*zhaizi,*	*xianzai*	*shi*	*sige*	*zhaizi,*
time	is	one-CL	stockade-village	now	is	four-CL	stockade-village

我们	是	搬到	过去	大象	生存的	地方。
women	*shi*	*bandao*	*guoqu*	*daxiang*	*shengcunde*	*difang.*
we	be	move-to	past	elephant	live-NOM	place

'…You see, the (lit. that) stockade village where I live now… I estimate that while I was a child, the village was only one fourth of the present size, and now the village is four times bigger. We are moving into the territory where our elephants used to live.' ('Elephant' episode, page 14)

(9) 在 曼春满, 原来 那个 民族 文化 很快, 如果 不是
zai manchunman, yuanlail neige minzu wenhua henkuai ruguo bushi
in Manchunman original that-CL ethnic culture quickly if not

搞 旅游的话, 民族 文化 很快 就 消失了。
gao lüyoudehua, minzu wenhua henkuai jiu xiaoshile.
start tourism ethnic culture quickly then disappear

'At Manchunman, the (lit. that) original ethnic culture… if it were not for tourist business, the ethnic culture would quickly disappear.' ('Tourist' episode, page 13)

In (7), the underlined NP, *neige dixiashi* 'the (lit. that) basement', is a first-mention definite entity. The definite interpretation is based on an association set that buildings may have a basement. This association makes a definite and unique reading of the *nei* NP possible. In (8), *wozhude neige zhaizi* 'the (lit. that) stockade village where I live now' is also a first-mention definite referent. It is possible for the hearer to uniquely identify the existence of the entity in question based on the inference that people usually have a place to live and this entity must be referring to the place where the speaker lives. Moreover, with the relative clause *wozhude* 'I live + NOM (nominalizer)' the nominal itself provides enough information to help the hearer locate the existence of the entity upon hearing it. Similarly, the underlined NP in (9) *yuanlail neige minzu wenhua* 'the (lit. that) original ethnic culture' is another example of a first-mention, uniquely identifiable referent although it has not been mentioned in the previous text. The hearer is believed to have some knowledge that any ethnic culture and heritage has a long history and must have a beginning, a development and a present. Thus, the hearer can infer that it refers to the existence of a culture that is original, authentic, unchanged, and unaffected by the influence of the main culture.

As mentioned above, one striking difference between news and conversation registers is that of formality. News reports are formal and their texts are well-planned and well-revised. Thus we see long, complicated NPs with relative clauses and other modifiers embedded as is exemplified in (6). The addressee's identifications of definite references are facilitated by the eloquent descriptions contained in the long, complicated NPs. On the other hand, conversation registers are informal and, more importantly, spontaneous and unplanned. Thus, even the NPs appear to be very short. However, that difference does not adequately explain why uniquely identifiable *nei* NPs only emerge in conversation.

4. ANALYSIS. The central question is why uniquely identifiable *nei*—a potential definite article—only occurs in conversation registers. One striking difference between news and conversation registers is that news is a monologue while conversation is interactive. The interactive nature of conversation allows participants—the speaker and the hearer—to jointly negotiate the identification of discourse entities. Since conversation is interactive, the speaker is likely to assume the entity that he/she is going to introduce to the hearer is familiar, recognizable, and 'you know what I am talking about', because of the speaker's confidence in their shared knowledge and because of his/her chances to fix it if any confusion arises (see Goddard 1983, Himmelmann 1996, and Schegloff 1996). The following

examples from the data illustrate that the interaction in conversation encourages the use of *nei* as a familiar, recognizable or at least a uniquely identifiable entity, depending on how much prior knowledge the hearer shares with the speaker:

(10)

在	三十多	年	前，	吉他	几乎	是	他们	生命中的
zai	*sanshiduo*	*nian*	*qian,*	*jita*	*jihu*	*shi*	*tamen*	*shengmingzhongde*
at	thirty-over	year	ago	guitar	almost	is	they	life-ASSO

全部	色彩。	在	那段	特殊的	日子里，	吉他	是
quanbu	*secai*	*zai*	*neiduan*	*teshude*	*rizili*	*jita*	*shi*
whole	color-rainbow	at	that-CL	unique-ASSO	day	guitar	is

他们	心里	最大的	安慰
tamen	*xinli*	*zuidade*	*anwei*
biggest-ASSO	comfort	they	heart-in

'More than thirty years ago, the guitar was almost their whole life. During that unique period of time, [the] guitar became their biggest comfort.' ('Song of Youth' episode, page 1)

The underlined NP in (10) *neiduan teshude rizi* 'the (lit. that) unique period of time' occurs in this early introduction of the three guest speakers in the episode of *The Song of Youth*, in a context where some of the audience in their fifties or older may know exactly what this entity means: it refers to the unique period of time of the Chinese Cultural Revolution in the 1960's and 70's when many high school graduates were forced to go to the countryside to experience live as peasants, during which time the guitar was everything to them. The determiner *nei* is used to make reference to this familiar entity. To the younger audience, this underlined NP may be uniquely identifiable based on inferences drawn from the previous statement that 'over thirty years ago, the guitar was their whole life'. Similarly, in (11),

(11)

没准儿	就得	扛着	它，	就像	牛魔王	扛
meizhuner	*jiude*	*kangzhe*	*ta,*	*jiuxiang*	*niumowang*	*kang*
perhaps	have-to	carry-DUR	it	like	Niumowang	carry

那个	大	芭蕉扇	似的，
neige	*da*	*bajiaoshan*	*shide,...*
that-CL	big	palm-leaf-fan	like

'Perhaps [I had to] carry it (guitar) just like Niumowang carried the (lit. that) big palm-leaf fan.' ('Song of Youth' episode, page 2)

The location and the identification of the referent *neige da bajiaoshan* 'the (lit. that) big palm-leaf fan' is based on shared knowledge of the fictional character Niumowang and his big palm-leaf fan from the famous novel 西游记, *Journal to the West*. Since it is part of the culture, the speaker assumes that the hearer would be able to identify it. By using *nei*,

the speaker is guiding the hearer to connect the entity 'the palm-leaf fan' with the fictional character in order to identify the referent.

I use example (10) and (11) to discuss one condition that would favor the use of *nei* in conversation registers, while perhaps not in news reports; that is, the interactive nature of the conversation allows the speaker to introduce entities into the discourse context for the first time and yet to confidently assume that the hearer knows what he/she is talking about. The use of *nei* on the speaker's part shows this trust and this bond that they share certain prior knowledge. Moreover, the use of *nei* encourages the hearer to collaborate in a successful referential identification. Even if the identification fails, the speaker can always fix it during subsequent conversational interaction.

Besides conversational interactions that facilitate the use of *nei* for a first-mention definite NP based on inference, association set, and shared knowledge, another governing condition that favors the use of uniquely identifiable *nei* is the factor of referential salience. One of the criteria for deciding whether a referent is salient is to see if it will recur in the discourse as a topic around which the discourse develops, thus becoming the center of attention. Since topic and topic development are mainly characterized in narratives in conversation, for example, rather than expository writing like a news report, it makes sense that *nei* is found to occur in the conversation register and elicits important topic NPs. Consider (12) and (13):

(12)

我	举	个	例子,	在	我	拍摄的	一个	附近,	在	景洪
wo	*ju*	*ge*	*lizi,*	*zai*	*wo*	*paishede*	*yige*	*fujin*	*zai*	*jinghong*
I	take	CL	example	at	I	film-ASSO	one-CL	nearby	at	Jinghong

附近,	在	曼春满	那个	村寨...	我	再	举	个
fujin	*zai*	*manchunman*	*neige*	*cunzhai...*	*wo*	*zai*	*ju*	*ge*
nearby	at	Manchunman	that-CL	stockade-village	I	another	take	CL

例子,	在	曼春满...	曼春满的	变迁	就
lizi,	*zai*	*manchunman...*	*manchunmande*	*bianqian*	*jiu*
example	at	Manchunman	Manchunman-ASSO	change	just

说明了	这个	问题。
shuomingle	*zhege*	*wenti.*
illustrate-PFV	this-CL	problem

'I'll give you an example. In a nearby place, a place near Jinghong, at the (lit. that) stockade village of Manchunman... I'll give you another example, at Manchunman... The change at Manchunman illustrates this problem.' ('Tourist' episode, pages 12–13)

The underlined, uniquely identifiable *nei* NP *manchunman neige cunzhai* 'the (lit. that) stockade village of Manchunman' is the topic of this oral narrative. The speaker is telling a story of how the tourist business in the village helps maintain the original ethnic culture of the village. The story is thus built around this entity, 'the village', with *nei* used to signal

such an important and salient referent. Notice also the reoccurrences of the topic in the succeeding discourse in (13):

(13)

一个人	打更	肯定	要	害怕,	因为	我们	那个
yigeren	*dagen*	*kending*	*yao*	*haipa,*	*yinwei*	*women*	*neige*
one-CL-people	night-shift	surely	will	scare	because	we	that-CL

地方	农村,	我	下乡的	地方	是	大草原…
difang	*nongcun,*	*wo*	*xiaxiangde*	*difang*	*shi*	*dacaoyuan…*
place	countryside	I	went-countryside-NOM	place	is	big grasslands

我们	那个	地方	经常	有	一些	狼了,	狐狸了	出没…
women	*neige*	*difang*	*jingchang*	*you*	*yixie*	*langle,*	*hulile*	*chumo…*
we	that-CL	place	often	have	some	wolf	fox	appear

'It was surely scary if one person took a night shift all by himself in the open air because the place where we were was in the countryside. The place where I went to was big grasslands… There often appeared some wolves and foxes in our place.' ('Song of Youth' episode, page 2)

In the same fashion, the NP *women neige difang* 'the (lit. that) place of ours' in (13) is a first-mention definite entity uniquely identifiable on the basis of the inference that people have a place to live. The reason why *nei* is accompanied here is that 'the place' becomes the center of attention in the story. It is in this place that the speaker has experienced life with his best friend—his guitar, as we note that 'the place of ours' repeats again in (13).

In conversation, the speaker may choose to highlight an important referent due to his/her personal involvement and communicative intentions with the entity. Even in conversation register, the use of *nei* as a definite marker is not obligatory; many uniquely identifiable NPs occur without *nei* and only a small proportion of the total number of uniquely identifiable NPs are accompanied by *nei*. When the speaker does use *nei*, he/she intends to draw the hearer's attention to that important referent. In news reports, by contrast, fewer occurrences of *nei* seem to result from the fact that the news register tends to provide objective information with little personal involvement.

5. ONE MORE FINDING FROM THE DATA. I want to point out one more finding from the data; that is, *nei* is found to encode first-mention definite generic reference. Generic reference is generally used to refer to any members of the type in question. Gundel et al. (1993) call this type identifiable reference, meaning that an indefinite marker will be used before the NP when the speaker assumes that the hearer can at least identify the referent as a type, or all members of that type, not presumably as a specific individual token of the type. And according to Givón (1984:405–6), generic NPs can be definite, hence 'definite generic nominals'. Although generic NPs are non-referential, they can still be definite when in a discourse context their existence as a type is assumed to be activated or uniquely identifiable to the hearer in the same fashion as other non-generic NPs. In this study I find that

the uniquely identifiable *nei* is used to encode such definite generic reference. See examples (14) and (15):

(14) a. 被赢钱的 那个人, 可能 出 五百万 追杀 你。
beiyingqiande neigeren keneng chu wubaiwan zhuisha ni
lose-money-ASSO that-CL-person perhaps offer five-million chase-kill you
'The (lit. that) person who may lose money [because of you] would probably offer five million [Chinese dollars] to chase you and kill you.'
b. 很 有 可能...
hen you keneng...
very exist possible
'Possible....' ('Turn Back' epiosode, page 6)

In (14), the uniquely identifiable *nei* NP *beiyingqiande neigeren* 'the (lit. that) person who may lose money [in gambling]' is a first-mention, yet a definite generic nominal via unique identifiability. First, it is a generic reference due to the fact that it refers to a hypothetical, possible, uncertain future entity and therefore the NP 'the person who may lose money' is ambiguous; it may refer to anyone among those who may lose money during gambling, hence a generic reference (see Givón 1984:285–86 for further discussion on tenses and referentiality). Second, the underlined NP in (14) is uniquely identifiable and thus a definite generic nominal based on the discourse context of this short dialogue between A, the hostess, and B, the guest speaker. It happens that the guest speaker is a highly-skillful manipulator and his skill could easily make gamblers lose money. So the hostess is recounting a hypothetical situation in which the loser would probably want to chase the winner and kill him.

(15) ... 我 也 希望 以后 梁阿姨 应聘的 那个 单位
wo ye xiwang yihou liangayi yingpinde neige danwei
I also hope later Liang-Aunt apply-ASSO that-CL working-unit

也 能 用 她, 没错的, 相信我。
ye neng yong ta, meicuode, xiangxinwo.
too can hire her no-mistake believe-me

'I also hope that the (lit. that) working unit where Aunt Liang would apply for a job in the future would hire her. They won't be sorry, believe me.' ('Liang' episode, page 16)

Example (15) is a similar case. The underlined NP *yihou liangayi yingpinde neige danwei* 'the (lit. that) working-unit to which Aunt Liang would apply for a job in the future' only refers to a future possibility. It is uncertain and thus again generic reference. However, the NP is familiar and accessible to the hearer since the whole conversation topic preceding this excerpt is about how Aunt Liang, although a traditional college student in her late forties, would make herself a very competitive candidate for any future working units.

6. CONCLUDING REMARKS ON THE STATUS OF *NEI* AS A DEFINITE ARTICLE. In sum, this study, based on news and conversation data, has provided some important empirical evidence showing the patterns and development of the demonstrative determiner *nei* into a definite article. I agree with Chen (2004:1177) that 'there is no simple, fully grammaticalized marker of definiteness in Chinese, like the definite article in English', especially since I feel that the use of *nei* to encode definiteness is not obligatory, as seen from the uniquely identifiable NPs of the news broadcasts and many uniquely identifiable NPs from the conversations that have no *nei*. However, this study seems to catch some behaviors of *nei* during a transitional stage to becoming a definite article. In other words, it is becoming a more 'deictically neutral determiner of definiteness like English *the*' (ibid). What we know now from this limited study is that this gradual grammaticalization process from a pure demonstrative to a more deictically neutral signifier of definiteness seems to appear first in spoken interaction in conversation genres. Moreover, a pattern seems to be emerging that the use of *nei* is spreading from referring to previously mentioned entities (forty-three instances in this study) to first-mention uniquely identifiable accessible referents based on shared general knowledge, familiarity, and inference (fifty-five occurrences in this study). Furthermore, there are signs that the spreading is beginning to cover definite generic reference as well, reference that is familiar to the hearer as a type, but still uncertain as to specificity, since it denotes no more than a future possibility. What does the future look like for the determiner *nei*? Will *nei* become grammaticalized first in spoken Chinese and then move to other genres like news broadcasts? We will continue to monitor its development closely.

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[2] Talk show episode examined in this study are: 'Kids Who Want to be Movie Stars' (31 March 2005); 'Teacher Wei's Conscientiousness' (16 April 2005); 'Not Too Late to Turn Back' (23 April 2005); 'Dancing with Elephants' (9 May 2005); 'People in the Tourist Center' (22 May 2005); 'Think Three Times before You 'Sign'' (24 May 2005); 'The Song of Youth' (30 May 2005); 'Why Do You Want to Lose Weight?' (7 June 2005); 'Who Can Make Kids Come Out of the Game Room?' (21 July 2004); 'To College Came Aunty Liang' (23 March 2005). News episodes examined aired on the following dates: 20 April 2005, 27 May 2005, 6 June 2005 and 17 July 2005.

[3] Chinese examples are transcribed in the Pinyin system with tones suppressed. The abbreviations used in the glosses are: ASSO = associative (*-de*), BA = a pretransitive marker, CL = classifier, NOM = nominalizer, PFV = perfective aspect (*-le*)

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THE ACQUISITION OF ENGLISH BY A NIGERIAN PRE-SCHOOLER

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AS PART OF THE EFFORTS to describe English as an international language (Crystal 1997, Bamgbose 2001, Brut-Griffler 2002, and Bolton 2005), the Nigeria English Studies Association (NESA) and its journal (*JNESA*) have for the past three decades focused on the use of English (spoken or written) by adults and children of school age (i.e. six years and above). This is, perhaps, a reflection of the fact that English is a second language, which is learnt mainly in the formal, classroom setting. This development has led to a neglect of the use of English by a significant population of Nigerian children who acquire the language before they attain school age. Since its debut in the 1960s, there has been no edition or issue of JNESA on child language studies, just as articles on the acquisition of English by pre-schoolers are conspicuously lacking. But the language of these under-six pre-schoolers, who are found in every part of the country, also deserves scholarly attention. Their type of spoken English is worthy of linguistic analysis within the framework of Nigeria English (NE) studies, just as empirical investigations are conducted on adults and school age children. The main objectives of this paper, therefore, are to i) draw attention to the acquisition of English by a Nigerian pre-school age child; ii) highlight the linguistic features and varieties of NE spoken by the kindergartener; and iii) stress the relevance of applied linguistics and pedolinguistics (child language studies) to research on varieties of NE. The data discussed in this paper are extracted from a doctoral dissertation by Ndahi (1982), which is a case study on Second Language Acquisition of English by a girl between 47 and 62 months. The data which are contained in Volume Two of Ndahi (1982) were collected through audio and video recordings (see also Surakat 1992a, 1992b, 2001, 2002, and 2004).

ENGLISH LANGUAGE IN NIGERIA. Nigeria has a population of 120 million people (2004), and 449 languages and ethnic groups (Hansford *et al.* 1976; cf. Odumuh 1990:48). English is the official language, the principal lingua franca, the language of wider communication, politics, administration, mass media, and international commerce, as well as the medium of instruction at all levels of education. Proficiency or a certificate in English is required of anyone who aspires to elective or public office, and anyone who wants to function outside his immediate linguistic environment. In essence, all Nigerian children are expected to be trilingual as a matter of policy, because in addition to the mother tongue, a child is expected to learn another major Nigerian language as well as English while in school (see National Policy on Education, NPE 1977, 1981 and 1998). English has been in use in Nigeria for a century and half and can no longer be regarded as a foreign language. What this paper attempts to show is that English has been undergoing a gradual process of nativization or

indigenization (Ndahi 1990) for over two decades now, and some children acquire (not just learn) it, either as a Second or First Language (see also Surakat 1992a and 1992b).

A trend which became noticeable in the 1980s is that many elite, upper and middle class parents deliberately encourage their children to acquire English, only or simultaneously with indigenous languages. This is attributable to the prestige attached to a good command of the language. There are also economic and academic advantages associated with English. A Credit pass in English is required by most employers and for admission to institutions of higher learning. In short, failure in English places one at a disadvantage in terms of employment, further studies, and other areas of national life. The failure rate in English (i.e. candidates who scored below Credit) for the Senior Secondary Certificate Examinations between 1988 and 1999 is as high as 80% or more (Mohammed 1995:150, Bamgbose 2001:362). There is also a close correlation between failure in English, and poor performance in other subjects (Mohammed 1995:133 ff.). Consequently, parents see early acquisition of good English as a strategy to avoid failure. In actual fact, some parents prefer to send their children to very expensive schools where it is believed that the standards are high enough to ensure adequate mastery of English. This is the situation in the many cosmopolitan university settings and urban centres across the country.

VARIETIES OF ENGLISH IN NIGERIA. Although there are regional or ethnic variations, there are generally four varieties of Nigerian English (Bamgbose 1971, 1995; Adesanoye 1973; Ubahakwe 1979; Jibril 1979, 1982; Banjo 1971, 1989 and 1995; Jowitt 1991/2000; and Surakat 1992c). These are:

i. Non-Standard Nigerian English (NSNE) or Broken English which is associated with people without formal, western education and those who have not attained more than primary education. (This variety is not found in the data analyzed in this paper);
ii. Nigerian Pidgin English or just Nigerian Pidgin (NP), which is now regarded as a distinct language on its own (a mixture of English and some indigenous languages). It is now undergoing a gradual process of creolization, particularly in the south-east. (This is the variety Mana, the subject, acquired before moving to the university environment);
iii. Standard Nigerian English (SNE) or Educated Nigerian English (ENE) which Jowitt (1991/2000) refers to as Popular Nigerian English (PNE). This is the most prestigious and acceptable variety of NE, and the focus of description in this paper;
iv. 'Been-to English' or 'Been-to Accent' (with a derogatory connotation) associated with outlandish style, or with people who try to mimic the speech mannerisms of native speakers (of either Standard American or British English).

Nigerian English is a cover term for the varieties and sub-varieties of English found in Nigeria. However, it is often used in a more restricted sense, such that NP and Been-to accent are excluded. In this case, only NSNE and SNE (i.e. ENE or PNE) qualify as NE. For a detailed discussion of the phonological, lexical, syntactic, and semantic features of these varieties,

see Odumuh (1981, 1990), Jowitt (1991/2000), and so on. It is pertinent, however, to state that mother-tongue interference—at virtually all levels of linguistic analysis—is a normal occurrence in second language acquisition contexts, and SNE is no exception. At the level of phonology, for instance, many SNE speakers find it difficult to articulate correctly certain RP phonemes (segmental as well as supra-segmental) which are lacking in their first languages. Thus, a word such as *van* may be realized as [fan] by some Yoruba speakers of English simply because the voiced labio-dental fricative /v/ is not part of the Yoruba phoneme inventory (Surakat 1992c). Wrong placement of stress, particularly for multi-syllabic words, is also common among some SNE speakers. This is attributed to the stress-timed rhythm of English as opposed to the syllable-timed rhythm of most Nigerian languages. At the level of lexico-semantics, many SNE speakers use words such as *academicians*, *escort*, and *drop* in contexts where *academics*, *see off*, and *stop* or *alight* would have been more appropriate. Instances of tautology are also found in SNE speakers' use of *still yet*, *reverse back*, *although … but*, and so on. A few cases of syntactic deviation have also been observed as characteristic of SNE (see also Odumuh 1987; Banjo 1989 and 1995).

MANA, THE RESEARCH SUBJECT. Mana acquired Hausa, Bassa-Nge and Nigerian Pidgin (or NP) by the age of 42 months in Kaduna, after which she moved to Zaria. Hausa is the language of the immediate environment in both Kaduna and Zaria, while Bassa-Nge is her mother tongue. She was exposed to these languages as well as NP in a compound in Kaduna, where she interacted with some NP-speaking Igbo children. Data collection started when Mana was 47 months old, five months after she moved to Zaria, and ended when she was 62 months old. In Zaria, Mana was exposed to Standard Nigerian English (or SNE) at home, in school (kindergarten), and among her playmates. Mana's guardians were members of the senior university staff, and the university environment in Zaria provided her with more and better opportunities (i.e. in terms of quality and quantity) to acquire SNE than her Kaduna background. By the age of 62 months (i.e. in only 15 months) Mana had started speaking fluently a variety of English that approximated SNE (see sample utterances below).

SAMPLE UTTERANCES OF MANA (quoted from Ndahi 1982, vol. 2). (R=Researcher, M= Mana. M's utterances in double slashes, with adult sense in square brackets. M at 47 months, i.e. five months after her first exposure to SNE. Note that NP utterances of Mana in M.1—16 are italicized to distinguish them from her SNE utterances.)

R	Where's Auntie?
M-1	// *i don go Kaduna* // [she has gone to Kaduna]
R	*i don go Kaduna*? What for?
M-2	// *i say i go come back* // [she said she will come back, return]

R	What's wrong with you?
M-3	(touching her mouth) // is <u>paiming</u> me // [it's paining me]

M-4 // my mout is paiming me // [my mouth is paining me]
(It should be noted that M-3 and M-4 are more of SNE than NP and are therefore not in italics)

R Where's Victor?
M-5 // *i dei* // [he's around]
R Ehn? (What did you say?)
M-6 // *i dei for home* // [he's in the house]

R (writes on a piece of paper)
M-7 // *wetin you lait*? // [what did you write? or what have you written?]
M-8 // a peibi? // [a baby?]

R (looking for her keys)
M-9 (pointing) // *i dei for dat place* // [it's in that place]
M-10 (sometime later) // *wei di key*? // [where are the keys?]

M-11 (scribbles on a piece of paper) // ai lait peibi like dis // [i write baby like this]
M-12 // *ai do peibi, like dis* // [I draw baby, like this]
M-13 // *ai go do 'im hais* // [I will draw its eyes]
M-14 // *ai can do 'im 'and* // [I can draw its hand]

(M is together with Yusuf, a younger boy. Yusuf cries)
R What did you do to Yusuf?
M-15 // *ai no do am anytin* // [I didn't do anything to him]
R Did you beat him?
M-16 // *ai no beat am* // [I didn't beat him]

(R is collecting data in M's nursery school. M, at 51 months, has a problem opening her lunch-box; T=Teacher)
M-17 // Teacher, my box has spoil..., open it for me //
R Say 'please can you open it for me?'
M-18 // Please can you open it for me? //
T (opens box for M)
M-19 // Thank you //
M-20 (shortly after) // I have finish ... drinking //
M-21 (to T) // Please, can you close it for me? //

(M and R in a recording session; M at 51 months, looking at the cassette recorder)
M-22 // I want to hear my noise //
R What did you say?
M-23 //...my noise //
R You want to hear your noise?

M-24 // Yes //
R It's not your noise. It's your voice. You want to hear your voice. Say that.
M-25 // I want to hear my voice //

(M at 59 months; R arrives at M's family house and greets M and her pregnant guardian)
R (to M) What are you watching now?
M-26 // Television //
R Television. HABA!! (HABA is an exclamatory Hausa word, an interjection)
M-27 (changes topic) // You want to tape the baby? // [Do you want to video-tape the baby?]
R I want to tape the baby?
M-28 // Mm // [yes, that's what I said—a kind of affirmative response]
R Yes and where's the baby?
M-29 *(pointing to her guardian)* // ...in the mummy <u>stomas</u> // [baby's in mummy's stomach/belly].
(Note that it is customary in the culture for children to refer to their aunties/uncles as mummy/daddy)

(M at 62 months. M tells R about the trip M and another girl made to the market to plait their hair)
M-30 // Chichi cried and slept. Me I didn't cry. I didn't <u>slept</u> //
(M looks into R's hand-bag)
M-31 // You have a small purse. Mummy <u>have</u> a bigger purse. She <u>have</u> two <u>purse</u>... She <u>have the biggest, the biggest</u>....//

(M sees a red Volkswagen car, and points)
M-32 // That car over there, it's like Victor's mummy's car. It's like Victor's mummy's own. //

ANALYSIS AND DISCUSSION. M-1 to M-16 were recorded when Mana was 47 months old, five months after she relocated, moved to Zaria from Kaduna. At this point, NP was the best she could speak. For example, M-1, M-2, M-5, M-6, M-7, M-9, M-10, M-13, M-15, and M-16 are clear NP expressions. Features of interlanguage, inter-lingual transfer, and idiosyncratic jargon are also prominent in her speech at this stage. For instance, children acquiring their first or second languages generally engage in (phonological) sound substitution. Mana also exhibits that tendency as in *paiming* for 'paining' (M-3 and M-4) and *peibi* for 'baby' (M-8). In other words, Mana uses a bilabial instead of an alveolar nasal in M-3 and M-4, while replacing a voiced bilabial plosive with its voiceless counterpart in M-8.

There are also phonological substitutions attributable to mother tongue interference in Mana's speech as in [lait] for *write* (M-7); [dat] for *that* (M-9); [dis] for *this* (M-11 and M-12). The substitution of the voiceless and voiced dental fricatives with alveolar stops /t/ and /d/ are phonological features of some varieties of Nigerian English, including SNE. Similarly,

the use of the lateral /l/ in place of the rolled /r/ is common among the Bassa-Nge, which incidentally is Mana's mother tongue (see also Surakat 1992c).

Other observable features of Mana's segmental phonology include the intrusive glottal fricative as in [hais] for *eyes* (M-13); dropping it as in [ʻim ʻand] for *his hand* (M-14); and the realization of the voiced alveolar fricative /z/ by its voiceless allomorph [s] (M-13). These are all phonological features of SNE (see also Jibril 1979, 1982; Jowitt 1991/2000; and Surakat 1992c, 2000). In M-29, Mana uttered *stomas* instead of *stomach* a case of using a voiceless alveolar fricative [s] in place of a voiceless velar plosive /k/ for the word-final consonant. However, as she advanced in age and cognitive development, instances of phonological substitution gradually reduced in Mana's speech, except for those related to mother tongue interference.

The fact that Mana made steady progress in her transition from NP to SNE is also observable from the data, especially from 52 months onward as in M-17 to M-32. Her comprehension and production of supra-segmental phonemes of SNE (stress and intonation) are adequate for her age and level of development, at least within the SNE paradigm. Similarly, her vocabulary, though limited, can be regarded as appropriate and adequate for her level.

Mana's morphology, syntax, semantics and pragmatics are also viewed as acceptable within the SNE continuum, in spite of the many developmental errors associated with children of her age. For instance, the pronominal subject (it) is dropped in M-3, possibly because it is contextually understood. But the nominal subject (my mouth) is inserted in the recast (i.e. M-4). In M-17, Mana used *spoil* instead of *spoilt*, while in M-20 she used *finish* instead of *finished*. In M-10, the plural morpheme 's' is dropped, even though it is clear from the context that a bunch of keys is involved.

In M-22 and M-23, Mana's expressions are grammatically correct, but the inappropriate use of *noise* in place of *voice* can probably be explained as an instance of psycho-phonological confusion due to the near-rhyme in the words. And when she was reinforced by the researcher, who provided the correct *voice*, Mana used it; just as she took to correction when the researcher prompted her to say *please can you open it for me* (see M-17 and M-18 to M-21). M-30 and M-31 also provide apt illustrations of the lexico-grammatical features of children's language. In M-30, *Chichi cried and slept* is quite in order, but the next one, however, *I didn't slept* is a purely developmental error which is common even among children acquiring English as the mother tongue. At this stage, children have not yet fully learnt that the past tense verb *did* (with or without negation) can only be followed by another verb in the present tense. Similar issues can be raised about the expressions in M-31: *Mummy have* (sic) *a bigger purse. She have two purse* (sic). *She have the biggest* (sic). It is apparent that Mana has not acquired concord or subject-verb agreement. She also does not use the plural morpheme marker *s*, just as in M-10. In addition, she has yet to master the use of comparative and superlative adjectives. Over-generalisation of grammatical rules is common with all children, since they test hypotheses like little linguists. With time, age and cognitive maturity, they master the correct forms (Cattell 2000). But then, such expressions are also used by adult foreign or second language learners of English, due to improper mastery of morpho-syntax.

In spite of the developmental errors and features of inter-lingual transfer in Mana's speech, the transition from NP to PNE within a space of 15 months cannot be in doubt. In essence, at 62 months, Mana's linguistic/communicative competence is close to the level of Standard Nigerian English. From available data, she has mastered enough pragmatic awareness for conversation, including turn-taking, topic initiation, and so on. She shows appreciation to her teacher for opening her box (M-19), taking a cue from the intervention of the researcher, who asked her to use a polite request expression. When she finished drinking (M-20), she employed the polite request form creatively (M-21). She could also code-switch appropriately from one language to another; just as instances of code-mixing were observed in the larger data (see Ndahi 1982, vol. 2).

RELEVANCE OF PEDOLINGUISTICS TO NE STUDIES. Several studies have been conducted on NE in terms of variety differentiation, ethnic or regional variation, levels of internal acceptability and international intelligibility, language profile and preference, and so on. However, most of the studies are sociolinguistic in nature. There is a need, therefore, to raise relevant psycholinguistic issues. In addition, the emphasis on the English used by adults and school age children neglects the speech of pre-schoolers, which can also provide significant insights to NE studies. This neglect is probably due to the fact that English was originally associated with formal education only. But of course, times change, and the changes that started over two decades ago should not go unnoticed by researchers. It has been empirically demonstrated that English is being domesticated, indigenized, or nativized in Nigeria (Ndahi 1990), but the contributions of pre-schoolers to this process have not been properly identified and adequately documented (see also Surakat 2000 and 2001)

Varieties of English in Nigeria (written or spoken) were traditionally linked with level of education. For instance, Adesanoye (1973) identifies three varieties of NE based on education and occupation: Variety 1 is associated with primary school leavers and low-grade workers; Variety 2 with secondary school leavers, many university undergraduates, journalists and magistrates; and Variety 3 with university graduates, university lecturers, judges, editors, and sophisticated authors (see also Jowitt 1991/2000: 40). Many studies have tended to model these classifications with little or no modifications (Odumuh 1990:49, and Jowitt 1991/2000). According to Ndahi (1990:43), '[i]n Nigeria... level of usage of English generally depends... on level of education'. Although these classifications were based on empirical data, the reality today is that such classifications no longer suffice, due to several factors, some of which are discussed below.

In order to adequately explain issues related to language development, it is better to consider all relevant factors, including the cognitive, psychological, and sociolinguistic, which influence or facilitate language. Among the psycholinguistic factors are ACQUISITION versus LEARNING, and the AGE, MOTIVATION, PERSONALITY and ATTITUDE of learner. Other factors include INPUT, DURATION, or QUALITY and QUANTITY of the language to which the acquirer or learner is exposed. It is pertinent, therefore, to briefly discuss some of these factors as they concern the topic under consideration. Although the distinction between acquisition and learning may appear subtle or technical, there are fundamental differences between language acquisition from infancy, and language learning at school

age. Language acquisition takes a natural course based on exposure without recourse to formal tutoring. All things being equal, a child who is exposed to a language from infancy is most likely to attain higher proficiency than one who waits for classroom lessons at the age of six. The critical age hypothesis (or CAH), lateralization and fossilization are crucial in this respect. Whether we adopt Krashen's (1973,1981) six years, or Lenneberg's (1967) puberty as a model for CAH, the pre-schooler who is exposed to a standard variety of English in a natural setting all his/her waking hours would have an advantage over a six-year old, or an adult who has only a few hours in a week to learn formal English.

Motivation is also usually higher for the acquirer than the learner, even if both are children. Motivation is integrative for the childhood language acquirer but usually instrumental for the learner, whether a child or an adult. Similarly, a child who is an extrovert, highly intelligent, and has a positive attitude to the (culture and speakers of the) target language, *ceteris paribus*, should perform better than a child, or an adult with opposite qualities or attributes. In other words, a pre-school age child with the exposure and advantages of Mana should have higher proficiency in English than a Secondary School leaver who learnt sub-standard English from an ill-equipped, ill-motivated and untrained teacher in a public school in the rural setting. Moreover, Mana's rich exposure and university-environment background would be an added advantage when she goes to learn English in the formal setting. By extension, children in Mana's category are most likely, on completion of Secondary School education, to perform better in English than some undergraduates who did not enjoy Mana's exposure. Jowitt (1991/2000:38–50) points out some of the drawbacks of the intuitively attractive schema or theory which associates proficiency in English language with formal education or occupation. In particular,

> [E]xposure to English within the home during the years of infancy may well be the most decisive factor making for increased proficiency. It would surely not be hard to demonstrate that a child still in primary school may as a result of his familiarity with English at home be more generally proficient in English than a WASC (Secondary School Certificate) holder. His tendency towards greater proficiency is reinforced if in addition he comes from an elite family where English is frequently used. (Jowitt 1991/2000:39)

CONCLUSION. This paper shows that Nigerian pre-schoolers have been acquiring English either as L1 or L2 for over two decades now, even though there has been no proper recognition and documentation of the contributions of pre-schoolers to the domestication or nativization of English in Nigeria. The relevance of pedolinguistics to NE scholarship is also highlighted, particularly with reference to variety differentiation. The holistic approach which incorporates all relevant cognitive, psycho-social, educational and environmental factors which impact on language development has been advocated for research on NE. Age, motivation, personality, and attitude of the language developer should be considered along with duration, quantity and quality of linguistic input enjoyed by the acquirer or learner. It is counter-productive to neglect socio-economic background or profile of the

language developer because it may lead to errors in classification, and generalizations based only on superficial performance data.

Research on child language—in all its ramifications—should be intensified in Africa generally, but particularly in Nigeria where hundreds of mother-tongues co-exist with international languages such as Arabic, English and French (see also Emenanjo 1990). Apart from its significance to NE studies, child language research also provides insights for language teaching and learning, abnormal language development and remedy, language policy in bilingual education, as well as childhood bilingualism (particularly its effects on intelligence, language skills and performance at school). The National Policy on Education (1998:4) contains a rather bizarre clause, which if implemented, would make all Nigerian school-age children compulsorily quadrilingual. The document states,

> Government appreciates the importance of language as a means of promoting social interaction and national cohesion; and preserving cultures. Thus every child shall learn the language of the immediate environment. Furthermore, in the interest of national unity, it is expedient that every child shall be required to learn one of the three Nigerian languages: Hausa, Igbo and Yoruba (in addition to mother tongue). For smooth interaction with our neighbours, it is desirable for every Nigerian to speak French. Accordingly, French shall be the second official language in Nigeria, and it shall be compulsory in school.

Such is the practical consequence of lack of research on the health of a nation. If there were studies on child language, uninformed political leaders would have been advised against certain policies which are inimical to the development of tomorrow's leaders (see Unoh 1981, Emenanjo 1990, Jolayemi 1999, Bodunde 2004). Thus the importance of pedolinguistics to overall national development cannot be over-emphasized. Parents, as well as teachers, applied linguists, speech therapists, language pathologists, developmental psychologists, developmental sociologists, curriculum designers, and language policy experts are all interested in, and tremendously benefit from investigations into child language (Surakat 2001). This explains, in part, the proliferation of child language studies in the developed countries of America, Asia and Europe. 'Nigeria[,] the most populous and linguistically heterogeneous African country, provides a laboratory overflowing with resources for research in (child) language acquisition and learning' (Surakat 2004:235). This advantage must be exploited to the fullest.

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LANGUAGE INDEX

This index contains references to languages, language groupings (families, subfamilies, etc.) and scripts (writing systems) or other methods of language representation as they are analyzed or otherwise mentioned in the text. Due to the prevalence of English, all references to or use of English for purposes not related specifically to the analysis of English as a language (such as glosses or concept labels) are excluded. Language or dialect names are in **roman face**, language families and other groupings are in SMALL CAPS, and names of scripts or other language representation systems are in *italics*.

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